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AGROSTAN

A Case Study for the 1970 World Census of Agriculture

AGRICULTURAL ECONOMICS

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AGROSTAN: A Case Study for the
1970 World Census of Agriculture

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Chapter 1. AGRICULTURAL PROBLEMS

Agriculture has become a special concern of people and governments over much of the world. In most countries, this concern has been prompted by unsatisfactory economic performance of the industry. Significant gaps have developed between actual performance and desired performance. These gaps identify problems which have tended to become the focal points of national agricultural policies and programs. Although the mix of problems of greatest concern has varied from country to country, this variability is diminished when countries are classified according to their stage of economic development.

1. PROBLEMS IN DEVELOPED COUNTRIES

In the most developed economies, major attention has tended to focus on problems of over production, excessive stocks, depressed producer prices and agricultural-nonagricultural income disparities. In general, these countries have been highly successful in generating opportunities to increase the productivity of agricultural resources. They have made large investments in agricultural research and development activities, in rural education and in the industries supplying the farming sector with new, more productive capital inputs. In addition, the conditions conducive to exploitation of these opportunities by farmers have been relatively favorable, including motivation, incentives, availability of investment capital and credit, tenure arrangements and the political environment.[1] As a result, the average productivity of agricultural resources (measured output per unit of measured input) has increased rapidly. Not infrequently, production has run ahead of demand with heavy depressing effects on agricultural prices and incomes.

In the developed countries, food has been relatively abundant and cheap. Diseases associated with too little of the right kind of food are comparatively rare. However, there has been growing concern about the effects of obesity and overeating on people's health. Although per capita farm income has been high compared with that in the least developed countries, farm-nonfarm income disparities generally have been wide and persistent.

In many of the highly developed countries, the forces of rising agricultural productivity and other developments associated with rapid economic growth have exerted strong adjustment pressures on the agricultural industry. The industry has been adapting its organization and use of resources in response to these pressures.

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[1] The terms "farm" and "farmer" are used synonymously with the terms "holding" and "holder".

The number of farms has been declining. Farm size has been increasing. There has been a large shift of labor from farming to nonfarm work activities with an accompanying decline in farm population. In many areas, the release of labor on farms has exerted strong secondary adjustment pressures on rural towns and communities. And the flow of rural migrants has added to problems of the cities.

Although adjustment of the farm industries of the highly developed countries has been occurring at a fast pace in terms of historical standards, the changes have not been rapid enough to achieve reasonable economic balance and to eliminate disparities in income earning opportunities in farming. As a result, governments have established various kinds of programs to support farm incomes.

2. PROBLEMS IN DEVELOPING COUNTRIES

The developing nations, on the other hand, have been concerned with quite a different set of agricultural problems. In many of these countries, farm production has lagged behind population growth. Food has been relatively scarce and expensive. Large numbers of people have experienced various kinds of dietary deficiencies. Diseases associated with malnutrition have been common. Land has been a relatively important input in production and frequently its control and ownership have been highly concentrated. Rural poverty has been widespread.

In these countries, the machinery for generating opportunities to increase resource productivity has not been highly developed. There has been little investment in agricultural research, in the education of rural people and in the industries supplying new, more productive farming inputs. Moreover, the conditions encouraging farmers to exploit new opportunities for raising agricultural resource productivity have not been favorable. Rapid growth in farm populations has restrained the availability of resources for farm investment. Transportation and communication difficulties have retarded the development of well organized farm markets. Farmer incentives frequently have been impaired by private market power and by government policies aimed at holding down food prices for consumers. When new more productive farming inputs have been introduced, utilization by farmers has been limited by lack of credit, poor distribution facilities, high costs and outcome uncertainties. In some instances, land tenure institutions have discouraged producer motivation and agricultural investment.

In these countries, agricultural policies have tended to reflect concerns over high food prices, periodic famine conditions, low productivity of farm resources and control and ownership of agricultural land. Internal efforts to increase the supply of food have been supplemented by external grants and loans for technical assistance, food imports and various kinds of physical inputs. These supplementary contributions have been prompted in part by a concern in the more developed countries over a growing imbalance between population and food supply in many of the less developed regions of the world.

3. IMPACT ON DATA NEEDS

Although the mix of agricultural problems of greatest concern has varied among countries, efforts to deal with the problems have had the common effect of greatly increasing the need for knowledge about the economics of agriculture. Part of the need is for descriptive knowledge--information which characterizes and reports what is happening in the industry over time. Another part of the need is for analytical knowledge--information about the relationships which tie the various parts of the industry together and connect agriculture to the general economy and the economy of other countries. Since both kinds of information are based directly or indirectly on various kinds of numerical data, this has meant an increased need for more and better agricultural economic statistics.

At the present time, the quantity and quality of agricultural economic data varies widely among countries. The highly developed nations with the less pressing agricultural problems have the best supplies of data. These countries have invested substantial resources in data collection and processing. Even so, there are some serious deficiencies in the agricultural data available in these countries. In many of the less developed nations, the supply of agricultural economic data is very meager. Much of the limited data available is unreliable because of large errors of measurement. Faced with the most pressing agricultural problems, these countries have the least adequate data base for providing needed knowledge of the agricultural industry.

Questions

1. How do the agricultural problems of developed and developing countries differ?
2. How has the performance of agriculture influenced the need for agricultural economic data?

Chapter 2. DATA NEEDS IN AGRICULTURAL ECONOMICS

Much of the need for agricultural economic data arises from the agricultural problem-solving activities of government and private individuals and groups. Agricultural problem-solving activities refer to those tasks which are involved in making and implementing plans and arrangements that increase goal attainment in agriculture. Numerous decisions have to be made by individuals and groups and these decisions require information obtained from various kinds of agricultural economic data. If solutions to problems are to be efficient, an adequate supply of reliable data is essential.

1. PROBLEM DEFINITION

In the present context, an agricultural problem exists whenever there is a feasible alternative agricultural situation which the decision-maker views as more satisfactory (preferred) than the current or prospective agricultural situation. In relation to the preferred situation, the decision-maker considers the current situation as unsatisfactory in one or more respects. The characteristics of the more satisfactory (preferred) situation depend on the aspirations or goals of the decision-maker.[1]

For example, a government may view the current agricultural situation in its country as unsatisfactory because population is growing more rapidly than food supply and one of its goals for agriculture specifies that per capita food supply increase. The government then would have a problem of "growing food scarcity". Or, suppose wheat producers in a country are experiencing resource earnings substantially lower than those obtained by other agricultural producers and they prefer a situation in which earnings are comparable to those of other producers. Wheat producers would have a problem of "low resource earnings". This might be a problem for government too, if the government had a goal of equal income opportunities for all producers. However, this might not be a problem for wheat consumers if they prefer to have lower rather than higher prices for bread. And it might not be a problem for government if the government prefers an agricultural situation in which consumers have cheaper food and farmers less income to one in which consumers have more expensive food and farmers have higher incomes. Thus, what might be considered a problem from the viewpoint of one decision-maker may not be a problem from the viewpoint of another decision-maker, depending on the characteristics of their respective goal structures.

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[1] The rigorous formulation of these goals has been called the decision-makers "objective function" or "welfare function".

2. PROBLEM SOLUTIONS

A problem solution consists of transforming the unsatisfactory current or prospective situation into a more satisfactory (preferred) future situation. It involves doing those things which will change the situation from its current unsatisfactory state to a more preferred or satisfactory future state. Since there may be many alternative situations which are viewed as more satisfactory than the current situation, there may be many problem solutions. However, there may be one alternative situation which is preferred to all others. Transforming the current situation into the most preferred situation might be called the optimal solution.

The content of a problem solution is determined partly by various restrictions or restraints on the choices open to the decision-maker. These restraints usually include some limitation on the means or resources available for solving the problem (achieving higher goal attainment). At any given time, there also will be various "technological" restraints which set limits on what is "physically" possible and certain socio-economic restraints which affect the feasibility of particular solutions. In addition, the decision-maker usually will impose some "side conditions" which he wants the solution to satisfy. For example, the government in solving a problem of unequal income earning opportunities for farmers might want the solution to satisfy the condition that resources in agriculture be fully used.

2.1 *Phases in problem-solving*

The problem-solving process may be divided into several phases, three of which are especially relevant to this discussion. These are:

a. problem identification and description--specifying what the problem is and indicating its characteristics,

b. diagnosis--determining the "causes" or explaining why the problem exists, and

c. prescription--ascertaining the best way to solve the problem.

In this discussion of information needs in agricultural problem solving activities, the focus will be on government as the decision-maker in formulating and executing agricultural policies and programs. Other agriculturally oriented decision-makers (individual farmers, input suppliers, processors and consumers) have similar kinds of information needs but these usually are less extensive and more specific than those of government. At a later point, the information needs of the individual farmer in planning his farm business will be considered in some detail.

3. PHASE 1: PROBLEM IDENTIFICATION AND APPRAISAL

Since so much is heard about agricultural problems both in developing and developed countries, it might be assumed that these problems have been clearly identified and adequately described. But unfortunately, this assumption is frequently not true. Although there may be a strong and overt feeling on the part of government policy makers and others that the agricultural situation in a country is unsatisfactory in certain respects, the problems are seldom formulated in a way that permits an evaluation of their relative importance. Thus, it may not be possible to allocate efforts devoted to problem solutions according to the importance of each problem, which results in a less efficient use of problem solving resources. Frequently, the reason is that information needed for appraising the relative importance of different problems is not available.

3.1 *Goals*

For agricultural problems to be identified in a way that is most useful in achieving efficient solutions, two principal kinds of information are needed. First, there is need for information about the government's goals for agriculture. If goal information is adequate, the situations which are considered more satisfactory than the existing situation can be determined and fully described. Norms or criteria for evaluating the performance of the agricultural industry and for identifying improvements in performance can be derived. Second, there is need for information about the existing agricultural situation. If this information is adequate, the industry's actual performance can be fully described. By comparing actual performance and desired performance as given by the information on agricultural goals, performance gaps (problems) can be identified and appraised for relative importance.

It frequently happens that a government's goals for agriculture are poorly formulated from an operational point of view. Sometimes they are not made explicit and often they are ambiguous. When goals are explicit, the specifications are frequently vague without any indication of the relative importance assigned to different goals. Some of these difficulties stem from the nature of goals in a changing and uncertain world; others arise because of conflicts in the goal structures of individuals and groups represented in the government. Sometimes the formulation of agricultural goals is inadequate because policy-makers are not fully aware of the existing agricultural situation. In such cases, more and better information describing the existing situation may prompt a more complete specification of goals.

In many instances, however, information on agricultural goals may be sufficient to give some indication of the things policy-makers want changed and the direction of the changes wanted, even though it is not adequate for an assessment of problem priorities. The things which policy-makers want changed may be called the "target variables". Target variables might include such things as farm income, food and farm commodity prices, resource productivity, number and size of farms, farm population, agricultural investment, farm outputs, agricultural inputs, resource ownership and control, resource earnings and so forth. The specification of target variables depends on the goals to be achieved.

For problem identification and performance evaluation, measurements of the target variables are required. Data on the actual values of target variables are needed for describing the farm industry's actual performance. Some indication of desired (goal) values for these variables is needed in describing more satisfactory (preferred) performance. Performance gaps (opportunities to improve performance) then can be identified. If goal information is adequate, an assessment can be made of the relative importance of different problems.

4. PHASE 2: PROBLEM DIAGNOSIS

The diagnostic phase of agricultural problem solving activity is analytical in nature. It involves analysis to determine why a problem (performance gap) exists. Some people might say that this phase is concerned with the causes of the problem. But this may lead to over-simplification unless it is recognized that agriculture generally is an industry of interdependencies in an economy of interdependencies. Except in certain areas of some countries where agricultural households still are virtually self-sufficient, specialization, advances in farm technology and the development of a market organization have tied various parts of the industry and the general economy together in a complex system of relationships involving inputs, outputs and prices.

4.1 Input-output relationships

One important set of relationships links the inputs of farming resources with the outputs of farm products. These input-output relationships are physical in nature. They show how the output of a product is affected by changes in input, e.g. how the yield of corn is influenced by increasing amounts of fertilizer. In addition, they provide information about the substitutability of one kind of input for another, i.e. the relative productivity of different kinds of inputs. They also indicate how much of one kind of product has to be sacrificed to produce additional units of another product, i.e. substitutability between products in farm production. Finally, they provide information about economies of scale--how output changes when all inputs are increased or decreased in the same proportion.

Knowledge of these relationships is important in analyzing a large number of different agricultural problems relating to efficiency of resource use and differential resource earnings. Estimates of input-output relationships are derived from basic data on inputs in agricultural production and the outputs of farm products. Difficulties are encountered in the measurement of these variables, especially inputs. Many of these difficulties stem from qualitative changes which are not captured by the usual methods of measurement.

Measured input-output relationships in agriculture may change over time as a result of modifications in the quality and form of farming inputs. These modifications involve another set of relationships which are particularly important in analyzing problems of agricultural development. Changes in the form and quality of measured farming inputs occur in response to various opportunities to increase the productivity of agricultural resources many of which are made available by investment activities carried on outside of farming. For example, investment in agricultural research generates new technological knowledge which may become incorporated in new more productive reproducible inputs. When such inputs are offered to the farming sector at a price that is low in relation to their value productivity, the stage is set for changes in input-output relationships. Or, investment in education may change the future management capacity of farmers and thereby modify the productivity relationships with other inputs. Thus, knowledge of the connections between investment in agricultural research and education and changes in the productivity of farming resources is important for analyzing agricultural development problems.

4.2 Supply-demand relationships

In addition, there are two sets of supply and demand relationships that are especially relevant in analyzing agricultural price, income and resource utilization problems. One set involves the supply and demand relationships for farm products. The other set involves the supply and demand relationships for farming resources.

Domestic demand relationships for farm products show how consumption is influenced by changes in farm prices, the prices of substitute products, income and its distribution and population. Farm product supply relationships indicate the variables which determine the outputs of farm products. For example, they show how the output of a product is affected by a change in its price, the prices of competing products and the prices of farming inputs. Underlying the supply relationships for farm products are the input-output relationships. The input-output relationships together with the prices or opportunity costs of farm resources determine production costs.[2]

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[2] Opportunity cost refers to the return that is foregone when a resource is used for one purpose rather than another.

The demand relationships for farm resources furnish information on the variables determining the quantities of different resources which farmers want to use in farm production. For example, they show how the quantity of fertilizer input responds to a change in its price, the prices of substitute inputs and the prices of products which are produced by its use. The demand relationships for farming resources partly depend on the input-output relationships in production. Changes in the input-output relationships affect the demands for farming resources by changing the physical productivities of the inputs.

The supply relationships for farm resources provide information on the variables which determine the amounts of different kinds of inputs offered for farm production. For example, they show how the number of farmers entering agriculture responds to changes in earnings in farming and in nonfarm employments. The supplies of farming inputs purchased in the nonfarm sector (e.g. petroleum products, fertilizer and insecticides) are related to their production costs and to nonfarm demands. These, in turn, are linked to input-output relationships in the input supplying industries, the prices of resources used by these industries and nonfarm demands for products that are produced with these resources.

Thus, supply and demand relationships for farm products and farming resources are interrelated and connected with technological and market developments in the general economy. Moreover, the farm industry of one country typically is linked to that of other countries via foreign trade. The total demands for farm products in a country may have an export demand component. The export demand component is related to import demands in the rest of the world and to export supplies in other exporting countries. Likewise the total supply of farm products in a country may have an import supply component. This is linked to export supplies in the rest of the world and to import demands in other importing countries.

4.3 Role of relationships in diagnostic phase

A major part of the research effort of agricultural economists is devoted to investigating the relationships that connect inputs, outputs and prices in agriculture. Knowledge of these relationships is needed for explaining the industry's past performance, for predicting and projecting the industry's future performance and for determining the consequences of alternative policy actions aimed at modifying the industry's performance.

In the diagnostic phase of agricultural problem solving activity, the objective is to explain why a particular agricultural problem exists, i.e. what causes the difference between actual performance and desired performance.

For example, suppose the problem is identified as one of disparity in labor earnings in farming, i.e. returns to labor in farming that are below those obtained by comparable quality labor in nonfarm employments. In the diagnostic phase, the objective then is to explain why this is true. From a knowledge of economic theory indicating the relevant variables and relationships, one or more hypotheses (possible explanations) can be formulated. Two possible hypotheses for the example under consideration might be "adjustment lag" and "high relative valuation (preference) of non-income attributes associated with farming by farm workers". Information about labor supply and demand relationships in farming would be needed to test these and other hypotheses. With this information, it would be possible to determine what hypotheses were supported or rejected by the evidence. In this way, the explanation of low labor earnings in agriculture which was most consistent with the facts could be established.

If problem diagnosis is to be accurate so that efficient policy actions can be designed and implemented, there must be reliable estimates of the relevant agricultural economic relationships. Such estimates, however, can be no better than the data on which they are based. Consequently, accurate data of the kind needed in making these estimates are an essential ingredient in the ultimate solution of agriculture's economic problems.

5. PHASE 3: PRESCRIPTION

The prescriptive phase of agricultural problem-solving activity involves (1) analysis of the consequences of utilizing alternative policy instruments (action programs) and (2) selection of those instruments that are most efficient in eliminating performance gaps.

In the diagnostic phase, information is generated which indicates the variables that must be affected and how they must be affected if performance gaps are to be eliminated. For example, suppose a performance gap is identified as "too slow an increase in the productivity of agricultural resources". Diagnosing this problem would involve an analysis of the factors that determine growth in agricultural resource productivity. This might include such things as agricultural education and research, the production and pricing of fertilizer, foreign trade policy, land tenure and so forth. Such an analysis would show what factors influenced agricultural productivity and what changes in these factors would be needed to obtain various increases in agricultural productivity.

Usually there is more than one kind of program or method that can be used to bring about changes in the factors that cause or explain a particular problem or performance gap. These alternative programs are not likely to be equally effective in inducing the desired changes. Moreover, they are likely to have different effects on other aspects of the agricultural situation. These side effects may be desirable in that they help to eliminate other performance gaps or they may be undesirable in that they create or increase other performance gaps. For example, greater farmer incentive to expand production might be provided either by a program which increases prices received by farmers or by a program that reduces prices paid by farmers for such things as fertilizer, water, seeds, etc. However, the effects on consumer food prices and on political stability could be vastly different. Because of interdependencies in the economy, programs designed to accomplish one goal may have important consequences for other goals.

Thus, each program alternative needs to be analyzed to determine (1) its capacity to eliminate the particular performance gaps for which it is designed and (2) its likely "side effects"--its likely effects on the attainment of other objectives or the elimination of other performance gaps.

5.1 *Selection of efficient programs*

The most efficient program alternative will be the one which, on balance, is expected to move the actual situation closest to the most preferred situation, taking account of desirable as well as undesirable effects. It is possible that some program alternatives might induce a set of consequences which involve more undesirable changes than desirable changes. Implementation of such programs, of course, would worsen the agricultural situation because costs (undesirable changes) exceed benefits (desirable changes). But among program alternatives offering benefits in excess of costs, there is likely to be wide variation in the ratio of benefits to costs. Efficient use of problem solving resources implies that program alternatives offering high benefit-cost ratios should be selected for implementation before those offering low benefit-cost ratios.

If the full consequences (effects on all relevant goals) of program alternatives are to be identified and measured, there must be knowledge of the relationships which tie inputs, outputs and prices together inside and outside of agriculture. In addition, information is needed on the factors which are involved in the efficient organization and administration of program alternatives. Successful program implementation is heavily dependent on a proper balance between administrative needs and administrative capabilities. A program that requires far more administrative resources than those available may be doomed to failure before it gets started. Since specific program alternatives are likely to be innovations in a particular country, there may be no data available on program experience which can be used in deriving information for appraising program organization and administration. However, some essential information may be obtained from data on the experience of other countries with similar programs or from data relating to the country's organizational and administrative experience with other kinds of programs.

6. *TIME SERIES AND CROSS-SECTIONAL DATA*

For agricultural problem-solving purposes, data are needed for describing and explaining past agricultural developments, for predicting and projecting future agricultural developments and for specifying agricultural policy goals and analyzing the consequences of alternative policy actions. These needs may be met partly by time series data and partly by cross-sectional data.

Time series data are measurements of a variable made at successive points in time. An example would be data on the production of corn each year over a period of years. Time series data are illustrated in Table 2A. Such data are like a motion picture; they portray the situation over a period of time. Cross-sectional data refer to measurements made at a given point in time. They are more like a still picture in that they portray the situation at a particular time. Cross-sectional data are illustrated in Table 2B which shows selected characteristics of the agricultural labor force of a hypothetical country on January 1, 1967.

Time series data are generated by regular or periodic reports, surveys or census, whereas cross-sectional data usually are collected by special surveys or census designed to obtain data that are not available in time series. Sometimes both types of data covering particular variables may be available as a result of independent data gathering operations. In such cases, estimates based on one type of data may provide a check on estimates based on the other type. For example, certain characteristics of demand relationships for farm products have been estimated from both cross-sectional data and time series data. If coverage and quality are the same, time series data are always preferred to cross-sectional data because they provide more information.

Table 2A. ILLUSTRATION OF TIME SERIES DATA FOR WHEAT ACREAGE, YIELD AND PRODUCTION IN A HYPOTHETICAL COUNTRY: 1960-67

Year	Acreage planted (million acres)	Yield per planted acre (bushels)	Production (million bushels)
1960	42.6	25.2	1,073.5
1961	41.5	17.6	730.4
1962	36.7	22.4	822.1
1963	42.3	20.5	867.2
1964	39.5	23.0	908.5
1965	43.1	24.2	1,043.0
1966	44.0	23.6	1,038.4
1967	45.2	25.0	1,130.0

Table 2B. ILLUSTRATION OF CROSS-SECTIONAL DATA OF SELECTED CHARACTERISTICS OF THE AGRICULTURAL LABOR FORCE OF A HYPOTHETICAL COUNTRY: 1 JANUARY, 1967

Characteristic	Unit	Number
Number of workers	thousands	534
Age	years	38.3
Schooling completed	years	7.6
Proportion male	per cent	62.3

Questions

1. Define an agricultural problem.
2. What is meant by a "problem solution"?
3. Identify and describe three phases in problem solving activity.
4. What role do goals play in problem identification?
5. What is an input-output relationship?
6. What is an "efficient program"?
7. Distinguish between time series data and cross-sectional data.

Chapter 3. AGRICULTURAL INPUT DATA

Agricultural input data refer to the numerical measurements of the resources and resource services which are used in farm production. Ideally, these measurements should fully explain the levels of output of farm products, except for a random error. There are two kinds of input data that are especially important for agricultural problem-solving activities: (1) measurements of the total quantities of each kind of resource and (2) measurements of the quantities of each resource devoted to different uses. Historically, the resources used in farm production have been classified as land, labor and capital. Although this classification has some serious limitations, it continues to be used and will be used in this discussion.

To be most valuable, input data should be collected on an individual farm basis. This will permit the construction of estimates covering the widest range of aggregation. For example, it will permit estimates for individual farm analysis, for regional analysis and for national or even international analysis. However, the collection of individual farm data by use of census or sampling techniques is expensive. High costs may force the use of other sources of data which may permit estimates only on a regional or national basis.

1. LAND

Agricultural land usually is defined to include the natural properties of the soil, topography, site and some or all of the reproducible capital inputs that have been embedded in or attached to land such as fences, terraces, water control structures, etc. One of the striking features about agricultural land is the wide variation in its qualitative attributes. This gives rise to difficulties in measuring land input in farm production.

1.1 *Measuring land input*

The most common practice has been to measure the input of land in terms of units of area--acres or hectares. If land quality does not vary appreciably, measurement in terms of area will give a reasonably good indication of effective input. However, if there are wide differences in quality, as is typically the case over large geographical areas, this unit of measurement will give a poor indication of land input. Since cultivated land or land in crops tends to be more homogeneous than all agricultural land, area of cultivated land or cropland sometimes has been used as a measure of land input.

The value (price) of land tends to vary directly with its productivity, which reflects its qualitative attributes. Thus, if qualitative differences are large, a more accurate measure of effective land input may be provided by the total value of land; for example, areas of different quality lands weighted by their respective prices. In some countries, soil survey information is becoming available in sufficient quantity to permit the classification of land according to productivity ratings. This holds promise of offering a more accurate basis for measuring the effective input of land.

1.2 *Land use*

Data on agricultural land use show the quantities of land devoted to the production of various crops and other uses. Land use classifications usually include the various annual, perennial and permanent crops, pasture, idle and waste land and land in farmstead, roads and miscellaneous uses. The classifications generally exhaust the total quantity defined as agricultural land. Such a classification is illustrated in Table 3A with data for the United States.

1.3 *Land tenure*

Another important kind of land information is provided by data on tenure. Farm land may be operated under various control arrangements, including outright ownership, cash lease and different types of crop and livestock share leases. Share leases typically indicate the input contributions to be made by the landlord and tenant and how each will share in the outputs. Unless the terms of these leases provide for the sharing of outputs in proportion to input contributions, they may encourage a less efficient use of resources and lower income. Lease arrangements also may influence operator incentives by affecting the distribution of rewards between landowners and tenants. If the lease makes no provision for compensation for unexhausted improvements made by the tenant, farm investment may be adversely affected. Data on land tenure are essential in the analysis, design and evaluation of land reform programs.

Table 3A. AGRICULTURAL LAND USE FOR A HYPOTHETICAL COUNTRY; 1959

Major use	Million hectares
Total	137.3
Cropland	
Used for crops	35.9
Idle or in cover crops	3.3
Used for pasture only	6.6
Grazing land	78.5
Forest and woodland pastured	9.3
Farmstead, roads and lanes	3.7

2. LABOR

Human effort in agriculture is used up in performing numerous manual tasks in crop and livestock production and in making various managerial decisions. In countries experiencing rapid economic growth, an increasing proportion of the human efforts devoted to farm production has been used in making managerial decisions. One reason is that new forms of power and machinery have replaced labor in many manual tasks in crop and livestock production. Another reason is that the dynamics of rapid economic growth have enlarged the need for management by increasing the number and complexity of the decisions that have to be made. For example, the effort which farmers in highly developed agricultural societies must spend in keeping abreast of the latest technological developments has increased as a result of the speed with which new farm technology has been made available.

2.1 *Measuring labor input*

It has been common practice to measure labor input in agriculture in terms of number of workers. Some countries also have used man-hours or man-years of farm work as units of measurement. These measurements are subject to some of the same difficulties that are inherent in the use of area units in measuring the input of land. Obviously, farm labor is not a homogeneous input. When workers or man-hours of different productivity are simply added together without appropriate weighting, the result may be a very poor representation of effective labor input. This is particularly troublesome for comparisons involving different mixes of labor qualities. It also is troublesome in comparing changes in labor input over time, when average labor quality has been increasing as a result of investments in the human agent, e.g. education. When input-output relationships for agriculture are estimated from data which do not properly take account of the long-run increase in farm labor quality, the results underestimate the contribution of labor to increased farm production. As a consequence, too little importance may be attached to investments in the human agent as a means of increasing agricultural productivity.

2.2 *Types of agricultural workers*

Workers in agriculture fall into two main classes on the basis of compensation: (a) wage or contract workers and (b) non-wage or residual income workers. Wage workers are those whose rewards for providing farm labor services are fixed in money and/or in kind per time or piece unit by contract or fiat. The level of reward of these workers is not dependent on how much income is currently produced by the farm. Non-wage or residual income workers are those whose rewards are determined by the amount of income produced by the farm. In some cases, the reward may be set as a percentage of the crop or net income of the farm. In other cases, it may be an unallocated share in the combined income produced by land, labor and capital or some combination of these inputs.

In countries where farms typically are operated as family units, non-wage or residual income workers consist of farm operators (persons responsible for management decisions) and other family members who contribute labor services on a non-wage basis. If the family contributes some land or capital in addition to labor to the production process, the reward for residual income labor will be included in the total return to the family's farming resources. Usually, the family draws on this income for consumption and investment purposes without allocating specific amounts to each of the resources producing the income. Sometimes a return to operator and family labor is computed by assigning going rates of return to other resources and subtracting the resulting opportunity costs from total income to give a residual return to labor. Imputational methods also may be used in estimating return to labor and other resources when appropriate data are available. Data on labor input are illustrated in Table 3B.

Table 3B. AGRICULTURAL LABOR FORCE IN A HYPOTHETICAL COUNTRY ON 1 JANUARY; 1960-67

Year	(In thousands)		
	Number of Wage Workers	Number of residual income and unpaid family workers	Total number of workers
1960	42.6	155.6	198.2
1961	38.5	154.7	193.2
1962	41.2	152.8	194.0
1963	37.9	153.4	191.3
1964	38.2	151.2	189.4
1965	36.8	149.8	186.6
1966	36.6	147.6	184.2
1967	35.9	148.0	183.9

Problems of underemployment in agriculture, reflected in relatively low labor earnings and large amounts of leisure time, have stimulated interest in improving measurements of the use of time and effort by farm people. In some countries, increasing amounts of data are being collected on the allocation and use of agricultural labor for analyzing the factors which determine labor effort and reward. Special attention is being focused on educational investment as a determinant of labor quality, productivity and earnings.

3. CAPITAL

Agricultural capital usually is defined to include those reproducible physical farming inputs which are not embedded in or attached to land and labor. Among the items of agricultural capital would be found such things as work stock, breeding stock, tractors, machinery, hand tools, fertilizer, insecticides, pesticides, tractor fuel and machinery lubricants, seeds and feeds.

3.1 *Classification of capital*

Sometimes agricultural capital is classified as operating capital and fixed capital. Operating capital includes those reproducible physical inputs that are transformed into output in relatively short periods of time. Examples are feed, seed, fertilizer and petroleum products. Fixed capital includes those reproducible physical inputs which are transformed into output over longer periods of time such as work stock, tractors, machinery, breeding stock and hand tools. In typical farm accounting procedure, operating capital is charged as a current business expense, whereas the cost of fixed capital is represented by an annual depreciation charge.

3.2 *Measuring capital input*

Like land and labor, agricultural capital is not homogeneous input. Even in highly specific forms, units of the same class are not perfectly substitutable. For example, the effect of fertilizer on corn yields under given soil, weather and management conditions is dependent on the mix of phosphorous nitrogen and potassium (PNK) in the fertilizer. Thus, a fertilizer with one mix of PNK is not the same as a fertilizer with another mix of PNK. Of course, the classification of capital inputs might be carried to the point where every unit within a class is a perfect substitute for every other unit within the class. But this would require a very large number of classes and the classification would become difficult to use. For this and other reasons, most classifications of agricultural capital have involved the aggregation of capital forms into broader groupings exhibiting considerable heterogeneity.

Most forms of agricultural capital can be expressed in physical units--pounds of fertilizer, bushels of seed, number of tractors, etc. The aggregation of forms expressed in unlike physical units usually is accomplished by conversion into money values by multiplying physical quantities by per unit prices. The use of prices as weights in this procedure rests on the assumption that relative prices are proportional to relative productivities. Even though this is not likely to be strictly true in practice, this procedure probably is the best available for aggregating various forms of agricultural capital.

3.3 *New agricultural capital inputs*

Advances in farm technology frequently make their appearance in the form of new, more productive reproducible inputs. For example, a new variety, a new insecticide or a new machine may be developed which has a value productivity far in excess of the cost (price) of the new input. Producers then find it profitable to use the new inputs. The incorporation of these new inputs into the measurement of agricultural capital presents a number of difficult problems. Since the new inputs may be substitutes for some existing inputs, relative input prices may change. It may take many years for the new inputs to be adopted to the point where productivities are proportional to prices. Consequently, use of constant prices as weights may distort the measurement of agricultural capital. Unless appropriate price data are available on used fixed reproducible inputs, application of normal depreciation schedules to cost values of old equipment may result in underestimating the input of this kind of capital. In the highly developed economies where many new forms of reproducible farming inputs have been introduced, the difficulties in measuring capital inputs are reflected partly in the fact that the input measurements available explain relatively little of the large increases in farm output since World War II.

4. USE OF INPUT DATA

Measurements over time of the inputs in farm production provide one of the most essential kinds of agricultural data. Input data are used directly for descriptive purposes. More importantly, however, they enter into the making of numerous other estimates used in analyzing the performance of the farm industry and in evaluating alternative agricultural policies and programs.

4.1 Construction of input index numbers

Basic data on input quantities can be used to construct index numbers of total agricultural resource input and major input components. A series of such index numbers is illustrated in Table 3C. These estimates are useful in describing year to year changes and long-run trends in the farm input mix and in total resources absorbed by the farm sector. Estimates of farm inputs in conjunction with estimates of farm outputs can be used to derive a number of measurements of average resource productivity (measured output per unit of measured input). Resource productivity estimates are useful in identifying and describing agricultural development problems and in appraising the success of development policies.

Table 3C. INDEX NUMBERS OF FARM INPUT BY MAJOR SUBGROUPS FOR A HYPOTHETICAL COUNTRY, 1950-65
(1957-59 = 100)

Year	Total input	Farm labor	Farm real estate	Mechanical power and machinery	Fertilizer and lime	Feed, seed and livestock purchases	Miscellaneous
1950	101	142	97	86	68	72	85
1951	104	143	98	92	73	81	88
1952	103	136	99	96	80	80	88
1953	103	131	99	97	83	81	91
1954	102	125	100	98	88	82	91
1955	102	120	100	99	90	86	94
1956	101	113	99	99	91	91	98
1957	99	104	100	100	94	93	95
1958	99	99	100	99	97	101	100
1959	102	97	100	101	109	106	105
1960	101	92	100	100	110	109	106
1961	101	89	100	97	116	123	109
1962	101	85	101	97	124	121	113
1963	102	83	101	99	141	124	115
1964	103	79	102	101	155	123	120
1965	103	75	100	101	163	124	124

4.2 *Estimating input-output relationships*

Input data are necessary in preparing estimates of input-output relationships. Information provided by these relationships are needed in analyzing sources of increased farm output and the effects of government policies on agricultural resource productivity. Estimates of input-output relationships also are required for analyzing problems of resource inefficiency and income disparities in agriculture. They are useful in studying producer production response and in investigating demands for farm resources in appraising agricultural adjustment needs. Input data are required in estimating farm production costs which, in turn, are needed for estimating resource earnings and farm incomes.

Questions

1. Under what conditions may units of area (acres or hectares) provide a poor measure of land input?
2. What is meant by the term "residual income" worker?
3. What procedure is frequently used in measuring unlike forms of farm capital?
4. Indicate several uses for agricultural input data.

Chapter 4. AGRICULTURAL OUTPUT DATA

Agricultural output data refer to the measurements of the quantities (physical volume) of crop and livestock products turned out in the production process on farms. There are two important kinds of farm output data: (1) measurements of the production of individual farm products, typically expressed in physical units (e.g. bushels of wheat or hundreds of pounds of live cattle) and (2) measurements of various output aggregates or totals usually expressed in index number form (e.g. index of food crop output or index of total farm output). Estimates of output aggregates are derived in part from data on outputs of individual farm products.

1. MEASURING OUTPUT

Estimating the output of a particular farm product may appear to be a simple task of counting the number of units of finished product turned out in a specific period. In many cases, this is essentially true, although the counting problem is not always simple. But in some cases, it is more complicated. Consider the output of beef for example. At the beginning of a production period, there is some stock of beef cattle on hand measured in terms of weight. During the production period, various inputs (feed, labor, etc.) are used to increase the number of pounds of beef. Calves are born. Some animals may be sold. A few may be butchered for use in the farm household. Some may die. And others may be purchased. At the end of the production period, there also will be some weight of beef cattle in inventory. Now the output of beef that can be attributed to production activity during the period is measured by the weight sold plus the weight used in the home less the weight purchased plus or minus inventory adjustment. If the weight of the beef inventory at the end of the period is greater than the weight at the beginning of the period, the difference is added. When the reverse is true, the difference is subtracted.

When production is continuous and inventory changes and purchases are significant, estimates of output, based on quantities sold and used in the household, may be quite inaccurate. Although the production of livestock and livestock products may be continuous, purchases and farm inventories may not be significant in all cases. For example, farm purchases and inventories of milk and eggs are not likely to be important. They may be important in beef and hog production, however.

1.1 *Multiple counting of output*

Another complication that arises in

estimating farm output is that of multiple counting, i.e. counting the same output more than once. This is a problem whenever some products are used in the production of other products. For example, if the value of livestock output were added to the value of crop output in estimating total farm output, part of the value of crop output (that part fed to livestock) would be counted twice. It would be counted as crop output and again as livestock output, since part of the value of livestock output is represented by the value of feed consumed by livestock. This would make the value of livestock output much larger than it should be if it is to measure the output attributable to livestock production activity.

A common method of handling this problem is to include as output only that increase in value attributable to each specific production activity. This "value added" measures the net contribution of the activity. For example, in livestock production it would mean subtracting the value of farm raised feed fed to livestock from the gross value of livestock output. By adding up all the outputs on a net or value added basis, total output can be estimated without multiple counting. The value added by each production activity properly measures the contribution of each activity to total output.

2. CROP OUTPUT

Estimates of production of individual crops may be obtained directly from a sample of producers and blown up to regional or national totals. They also may be obtained by summing individual farm data collected by an agricultural census. Or, they may be derived from land use and yield (output per unit of area) estimates based on a combination of sample and census data.

Various classifications of crop output have been developed. In some countries, the classification includes food crops, feed crops and industrial crops. In other countries, a more detailed classification is used.

2.1 Index number of crop production

Index number procedures are used in making estimates of total crop output and its components. A common method of aggregating crop outputs is to multiply the quantities produced each year by a set of constant prices, sum the resulting annual values and express each sum as a relative of a base period value. The base period value usually is an average of the sums during a period of years. Price weights should be selected to give as good a representation as possible of the relative importance of each crop making up the aggregate. Average market prices during some recent period frequently are used for this purpose. A series of index numbers of crop outputs is illustrated in Table 4A. In this example, there are nine categories making up total crop production. The data show that between 1957-59, the base period, and 1965 total crop production rose 17 per cent. However, there was considerable variation among the different categories. Sugar production increased 39 per cent, whereas tobacco production went up only 10 per cent.

3. LIVESTOCK OUTPUT

Livestock output generally includes the production of meat animals, milk and milk products, poultry and poultry products and work stock. For meat animals, poultry and work stock, accurate estimates of output may require data on inventories, purchases, births, deaths, sales and household use. Such data can be collected only by a census or sample survey of farms. Lack of data on some of these items, however, may not be serious if they are of minor importance. Data on the outputs of milk, milk products and eggs produced on farms can be obtained directly from producers by a census or sample survey. Even with these products, data on farm dispositions can provide a useful check on the accuracy of producer estimates of production.

3.1 *Value added in livestock production*

If livestock production is based to a significant extent on farm produced feed, it is necessary to put livestock output on a "value added" basis so as to avoid double counting and overestimating the contribution of livestock production to total farm output. This can be accomplished by subtracting the value of feed fed to livestock from the gross value of livestock production. To obtain estimates of

Table 4A. INDEX NUMBERS OF CROP PRODUCTION FOR A HYPOTHETICAL COUNTRY: 1950-1965

(1957-59 = 100)

Year	Feed grains	Hay and forage	Food grains	Vegetables	Fruits and nuts	Sugar crops	Cotton	Tobacco	Oil crops	All crops
1950	81	89	86	96	98	94	82	117	71	89
1951	75	92	85	89	100	74	124	135	65	91
1952	79	90	109	90	97	76	124	130	63	95
1953	77	92	100	95	98	85	134	119	63	94
1954	81	92	88	93	99	95	111	130	71	93
1955	86	98	83	96	99	86	120	127	78	96
1956	85	94	87	102	103	86	108	126	92	95
1957	93	101	82	98	94	98	89	96	91	93
1958	101	102	121	102	102	96	93	100	111	104
1959	106	97	97	100	104	106	118	104	98	103
1960	109	103	115	103	98	102	116	112	105	108
1961	99	102	106	110	109	115	116	119	122	107
1962	100	105	98	108	98	119	121	134	123	107
1963	110	105	102	108	102	153	125	135	128	112
1964	97	105	114	103	111	156	124	129	128	109
1965	113	111	117	112	115	139	122	110	155	117

Table 4B. INDEX NUMBERS OF LIVESTOCK OUTPUT FOR A HYPOTHETICAL COUNTRY: 1950-1965

(1957-59 = 100)

Year	Meat animals	Dairy products	Poultry and eggs	Total livestock output
1950	89	93	78	88
1951	95	92	81	92
1952	95	92	82	92
1953	94	97	84	93
1954	98	98	87	96
1955	103	99	86	99
1956	100	101	94	99
1957	96	101	95	97
1958	98	100	101	99
1959	106	99	104	104
1960	103	101	104	102
1961	106	103	112	106
1962	108	104	111	107
1963	114	103	115	111
1964	116	105	118	113
1965	110	104	122	111

feed fed, data are needed on the disposition of farm raised feed crops. If inventory changes, purchases and home use are of minor importance for feed crops, rough estimates of feeds fed may be derived from data on crop production and sales.

3.2 *Index number of livestock production*

Estimates of aggregate livestock output usually are prepared by index number procedures similar to those used for crop output. Table 4B illustrates a set of such estimates for a hypothetical country. In this example, total livestock output is made up of three major components--meat animals, dairy products and poultry and eggs. The data indicate that between 1950 and 1965, total livestock production went up about 26 percent. Whereas the output of poultry and eggs went up nearly 56 per cent, the production of dairy products rose only 12 per cent.

4. TOTAL FARM OUTPUT

If data are available for estimating crop outputs and for estimating livestock outputs on a "value added" basis, estimates can be prepared of total farm output by use of index number procedures. Such estimates provide the best single measure of the overall output performance of the farm industry. Recognizing the special significance of food production, FAO has prepared two different series of total output for a number of countries. One series attempts to measure total food output. The other series attempts to measure total agricultural output, including both food and nonfood outputs. These series are illustrated for a selected number of countries in Table 4C.

Table 4 C. INDEX NUMBERS OF TOTAL FOOD PRODUCTION AND TOTAL AGRICULTURAL PRODUCTION, FOR SELECTED COUNTRIES: 1956 - 1965

(1952-1956 = 100)

Country	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
EUROPE										
Food production	107	110	120	110	124	130	132	141	139	125
Agricultural production	107	109	120	109	124	129	131	140	138	125
Belgium-Luxembourg										
Food production	99	104	107	103	117	117	124	131	121	123
Agricultural production	99	103	105	101	115	116	123	130	121	121
Denmark										
Food production	103	112	109	107	117	119	125	117	121	125
Agricultural production	103	111	108	107	116	118	125	117	121	124
Finland										
Food production	98	108	107	111	127	124	118	133	136	141
Agricultural production	98	108	107	111	126	123	117	132	136	140
France										
Food production	104	102	105	109	124	119	132	130	130	137
Agricultural production	104	102	104	109	124	119	132	130	131	136
Germany, Federal Republic of										
Food production	102	103	112	106	125	109	123	129	127	119
Agricultural production	102	103	112	106	125	109	123	128	127	118
Greece										
Food production	109	124	118	126	116	142	132	145	155	164
Agricultural production	110	127	119	124	116	143	136	152	157	163
Ireland										
Food production	105	113	104	99	111	123	119	121	124	116
Agricultural production	105	113	104	100	111	123	119	121	124	117
Italy										
Food production	104	102	117	117	110	122	123	116	125	128
Agricultural production	104	102	115	117	109	119	121	114	123	127
Netherlands										
Food production	98	104	112	112	126	123	135	128	128	125
Agricultural production	98	103	111	110	125	121	133	127	128	123
Norway										
Food production	107	104	99	98	105	105	104	104	100	99
Agricultural production	107	104	100	98	106	105	105	105	100	100
Portugal										
Food production	101	106	100	101	103	105	118	122	116	128
Agricultural production	101	106	100	101	103	105	117	121	116	127
Spain										
Food production	101	105	107	114	115	117	121	139	125	126
Agricultural production	102	105	107	115	116	120	124	140	125	127
Sweden										
Food production	100	99	96	97	101	100	104	97	105	103
Agricultural production	100	99	96	97	101	100	103	97	105	102
Switzerland										
Food production	97	101	110	107	114	115	111	112	112	116
Agricultural production	97	101	110	107	114	115	111	112	112	116
United Kingdom										
Food production	108	108	107	113	121	122	133	134	141	144
Agricultural production	108	108	107	113	121	122	132	133	140	144
Yugoslavia										
Food production	102	147	121	163	143	134	141	154	158	150
Agricultural production	102	147	120	160	140	131	138	152	157	148
NORTH AMERICA										
Canada										
Food production	106	91	96	99	105	88	114	127	118	129
Agricultural production	108	92	97	99	107	90	114	127	117	129
United States										
Food production	104	103	111	111	112	113	113	120	119	120
Agricultural production	103	99	106	108	110	110	112	118	117	117
OCEANIA										
Australia										
Food production	100	97	120	116	125	125	139	143	150	137
Agricultural production	106	100	119	119	124	126	134	139	145	133
New Zealand										
Food production	105	105	110	115	117	119	124	125	131	132
Agricultural production	106	107	113	119	122	123	129	130	134	140
LATIN AMERICA										
Argentina										
Food production	111	102	110	103	96	107	111	124	121	108
Agricultural production	110	102	111	104	97	108	111	123	120	108
Brazil										
Food production	110	118	123	126	131	137	141	145	153	170
Agricultural production	105	117	124	135	138	146	150	146	143	168
Chile										
Food production	107	104	118	111	114	121	119	127	128	121
Agricultural production	107	104	118	111	114	121	118	126	127	121
Colombia										
Food production	105	104	108	114	115	116	122	122	133	139
Agricultural production	101	103	112	117	121	121	127	129	133	140
Cuba										
Food production	111	113	115	117	133	106	91	100	122	101
Agricultural production	111	113	114	117	133	106	94	100	122	101
Guatemala										
Food production	103	103	106	110	114	118	135	133	136	140
Agricultural production	107	114	116	128	131	138	167	172	175	196
Honduras										
Food production	106	108	116	119	120	126	131	133	141	148
Agricultural production	106	110	119	122	122	125	137	140	149	157
Mexico										
Food production	116	128	137	137	139	150	157	161	177	182
Agricultural production	115	128	138	131	137	145	153	158	172	178
Panama										
Food production	108	115	121	123	120	130	131	136	139	156
Agricultural production	105	114	120	123	121	132	131	137	139	155
Peru										
Food production	98	101	107	112	121	123	126	126	132	131
Agricultural production	99	101	108	113	123	126	131	133	136	135
Uruguay										
Food production	97	98	86	76	90	92	96	92	103	101
Agricultural production	95	97	88	77	90	92	96	95	102	99
Venezuela										
Food production	107	113	114	121	134	135	147	159	168	176
Agricultural production	105	112	114	121	133	135	142	155	163	170
FAR EAST										
Burma										
Food production	107	93	111	117	117	121	132	132	142	134
Agricultural production	106	94	109	116	116	119	130	130	139	132
Ceylon										
Food production	98	102	102	110	116	121	130	138	151	132
Agricultural production	102	106	108	111	117	121	127	133	139	134
China-Taiwan										
Food production	113	120	127	125	132	133	139	138	158	165
Agricultural production	113	120	127	126	132	134	140	139	158	166
India										
Food production	106	106	111	116	122	124	122	127	131	123
Agricultural production	107	107	111	115	121	124	123	128	131	124
Indonesia										
Food production	104	105	110	111	113	110	117	108	119	113
Agricultural production	103	104	108	109	109	109	116	108	116	113
Japan										
Food production	110	113	119	118	120	121	132	129	133	133
Agricultural production	110	113	118	117	118	120	129	127	133	132
Korea, Republic of										
Food production	108	121	127	129	129	164	142	158	196	195
Agricultural production	108	119	125	127	126	160	140	153	188	192
West Malaysia										
Food production	110	112	117	118	134	147	148	157	152	166
Agricultural production	106	108	112	117	123	131	132	139	142	152
Pakistan										
Food production	105	107	106	115	120	121	121	130	130	133
Agricultural production	105	106	105	112	115	120	119	128	127	132
Philippines										
Food production	109	113	114	114	121	121	130	135	135	136
Agricultural production	109	114	115	115	123	123	134	138	138	137
Thailand										
Food production	111	93	106	109	123	130	141	152	148	150
Agricultural production	112	96	108	113	129	137	143	156	155	157
AFRICA AND NEAR EAST										
Algeria										
Food production	109	98	91	99	102	81	93	95	83	96
Agricultural production	106	97	90	97	101	78	91	92	81	94
Cyprus										
Food production	95	112	100	103	104	125	137	134	131	173
Agricultural production	95	111	98	103	101	121	135	132	130	169
Ethiopia										
Food production	103	107	104	122	126	130	132	134	139	141
Agricultural production	103	108	105	122	126	135	138	140	144	147
Iran										
Food production	112	119	120	127	122	130	130	138	134	141
Agricultural production	112	118	120	128	125	134	132	141	139	148
Iraq										
Food production	105	121	107	98	104	116	129	108	118	126
Agricultural production	105	122	108	99	105	116	128	110	120	126
Israel										
Food production	126	132	139	170	173	183	202	217	249	253
Agricultural production	126	134	141	174	180	193	213	223	258	268
Libya										
Food production	106	162	130	125	143	138	172	203	200	184
Agricultural production	107	158	133	128	140	140	171	199	196	180
Morocco										
Food production	106	90	120	109	111	87	117	124	124	133
Agricultural production	105	90	119	108	109	87	115	123	123	130
South Africa										
Food production	110	119	111	118	128	139	145	152	144	140
Agricultural production	109	115	111	117	123	134	137	144	137	135
Syria										
Food production	113	131	77	86	78	98	149	129	136	132
Agricultural production	116	135	91	99	95	113	159	145	159	157
Tunisia										
Food production	115	102	138	110	133	89	104	140	145	119
Agricultural production	114	102	137	110	132	89	103	138	143	118
Turkey										
Food production	108	107	125	124	126	126	131	138	137	134
Agricultural production	108	106	123	124	125	125	131	138	144	139
United Arab Republic										
Food production	112	115	112	119	125	117	138	141	143	148
Agricultural production	107	115	116	121	127	112	136	137	143	148

Source: United Nations. Food and Agriculture Organization. Production Yearbook. Vol. 20. Rome, Italy, 1966.

It should be pointed out that in some of the countries the basic data available for constructing these estimates are quite limited and unreliable.

The data in Table 4C indicate that nearly all of the 56 countries listed increased their food production during the 1956-65 period. The increases, however, varied widely. Two countries produced less food in 1965 than in the 1952-56 base period. In 13 countries, the increase was under 25 per cent. Increases of 25 to 49 per cent occurred in 29 countries. Twelve countries had increases of 50 per cent or more. In several countries, food production did not increase as rapidly as population.

5. USE OF OUTPUT DATA

Farm output data have a large number of descriptive and analytical uses in agricultural problem solving activities. They can be used to describe the output performance of the farm industry and its various crop and livestock producing enterprises. If farm output data are available for a series of years, they can be used to describe short-run production instabilities and long-run trends. Output instabilities are particularly important in analyzing and evaluating alternative storage policies.

5.1 *Measuring productivity*

In studying changes in physical productivity, output data along with input data can be used to derive various estimates of average productivity or yields. For example, total farm output per unit of total farm input can be computed. Estimates can be made of crop yields, output per man, milk production per cow, livestock output per unit of breeding stock and eggs per hen. These estimates are useful in describing agricultural development progress and in appraising development policies.

Output data are necessary for estimating input-output relationships in farm production. As pointed out earlier, these relationships are used in analyzing economic efficiency and income disparity problems in agriculture. Output data also are essential in investigating farmers' production response, in determining the sources of growth in farm output and in analyzing the effects of farm production policies and programs.

Questions

1. What are some of the conceptual difficulties encountered in measuring farm output?
2. Briefly describe the index number procedures used in measuring total crop and livestock production.
3. Discuss the uses of agricultural output data?

Chapter 5. PRODUCT UTILIZATION DATA

Farm product utilization data show the quantities of various farm products that move into different uses on and off farms. These uses sometimes are classified as intermediate uses and final uses. Intermediate uses are those in which the product is used as an input in further production. Final uses are those in which the product directly satisfies people's wants. For example, feed use is an intermediate use, whereas food use is a final use. Farm uses may include seed, feed, home use and inventory. Nonfarm uses may include food processing and various industrial outlets in which farm products are raw materials, trade and government inventories, exports and final consumption by households, businesses and government.

Utilization data may be obtained from a variety of sources. Data on farm dispositions usually are collected in a census or sample survey of individual farm units. Estimates of quantities going into nonfarm uses may be based on reports furnished by businesses buying agricultural raw materials, government trade agencies and final users of products of agricultural origin.

1. PRODUCT BALANCE SHEET

A useful device in collecting utilization data and in making utilization estimates is the "product balance sheet". This is illustrated in Table 5A with hypothetical data for two grain crops, wheat and corn. The various products are listed along the left side. In the first four columns along the top are listed the sources of product supply -- beginning inventory, purchases, production and imports. The fifth column lists the total supply -- the sum of the first four columns, i.e. the total quantity available for use. In the next several columns are listed the possible uses. In the example, these are limited to farm uses, including seed, feed, home use and ending period inventory. The last column lists the sum of the quantities utilized. The idea of a product balance is that the sum of the quantities going into various uses must exhaust the total quantity available for utilization. In other words, the total quantity in the last column must equal the total quantity in the fifth column.

The product balance can be applied to the individual farm as well as to an aggregate of farms. It also can be used in making national utilization estimates. It is a useful device because it provides a check on the consistency of the supply and utilization data. If data

Table 5A. Hypothetical farm supply and utilization, for wheat and corn: 1966

(In millions of bushels)

Product	Supply				Utilization					
	Beginning inventory	Production	Net purchases[1]	Total supply	Net sales[2]	Seed	Feed	Home use	Ending inventory	Total utilization
Wheat	100	700	25	825	650	35	25	5	110	825
Corn	300	2,000	10	2,310	150	5	1,800	10	345	2,310

[1] Purchases from nonfarm sources.

[2] Sales to nonfarm buyers.

are available on all but one of the items making up the product balance, the missing item can be estimated as a residual. This method, for example, is used in estimating feed grain utilization in the United States. However, if there are important errors in the data available and if these are not compensating errors, this procedure will result in an accumulation of errors in the item estimated as a residual.

2. INVENTORY DATA

Farm commodity inventory data show the quantities of farm products held as stocks for future use at particular points in time. There are two principal kinds of stock data for farm products: (1) data showing quantities held as inventory by farmers and (2) data showing inventory quantities held by nonfarm buyers or users, including government. Inventory data also may be collected by grades and by geographical locations.

Data on farm commodity stocks typically apply to the beginning or end of the production period. In the case of crops, the production period usually is defined as the crop year which runs from a date just prior to harvest to a date 12 months later. Estimates of crop stocks are made for the beginning of the crop year or for the end of the preceding crop year. When reference is made to stocks at the beginning of the crop year, the term "carry in" is sometimes applied, whereas the term "carry over" is applied to stocks at the end of the preceding crop year. The accounting period for livestock and livestock products frequently is the calendar year and inventory estimates are made for the beginning of the calendar year (end of preceding calendar year). In some countries, stock estimates are prepared on a quarterly or monthly basis for the more important farm commodities.

3. CONSUMPTION DATA

The ultimate use of products produced on farms generally involves a set or production activities carried on by what is sometimes called the farm marketing sector. These activities include (a) changing the form of farm products (e.g. transforming wheat into flour and flour into bread), (b) changing the location of farm products (e.g. transporting wheat in the form of flour from mill to bakery and in the form of bread from bakery to retail store) and (c) changing the time when farm products are available for use (e.g. storing wheat in the form of flour until it is needed in making bread). In some instances, final users consume farm products in forms that have little or no resemblance to the original products produced on farms. This is particularly true in the case of those farm products used as industrial raw materials.

Farm product consumption data show the quantities of farm products which move into final domestic uses during a specific period, usually a year. There are two broad classes of final consumption uses for farm products: (1) food uses and (2) nonfood uses, including such things as clothing, paint, glue, soap and tobacco products. Some farm commodities are used only to satisfy food wants; others are used only to satisfy nonfood wants and still others are used to satisfy both food and nonfood wants. Final utilization data are illustrated in Table 5B.

Final disposition data for individual farm products usually are expressed in physical units of weight or volume. Data covering groups of farm products generally are aggregated by use of index number procedures. For example, index numbers measuring the aggregate volume of farm products used for food may be constructed from data showing quantities of specific farm products used for food and from appropriate farm price data for weighting various product quantities. Likewise, index numbers measuring the volume of food consumption can be constructed from data showing the quantities of various kinds of food consumed and from appropriate retail food price data.

Table 5B. FINAL UTILIZATION OF CORN IN A HYPOTHETICAL COUNTRY, ANNUAL AVERAGE 1950-54 AND 1960-64

(In Million Tons)

Period	Use				
	Feed	Food	Industrial products	Exports	Total
1950-54	10.5	4.3	1.1	0.5	16.4
1960-64	12.6	4.1	1.4	0.8	18.9

4. FOREIGN TRADE DATA

From the viewpoint of an individual country, exports may be considered a final use for domestically produced farm products. Such exports, however, do not constitute a final use from the viewpoint of the importing country. From the latter's viewpoint, these exports are an addition to the total indigenous supply of farm products, and like domestically supplied farm products may flow into various intermediate and final uses. Thus, a country's exports of farm products may be viewed as a final use for its indigenous farm production and its imports of farm products may be viewed as a component of its total supply of farm products for ultimate domestic consumption.

Exports and imports of individual farm products typically are measured in physical units of weight or volume and/or in monetary units of total value. Time series data expressed in monetary units of total value reflect changes in both quantities and prices. For some purposes, measurements in value terms are appropriate, whereas for other purposes, measurements of physical volume are needed.

In measuring total farm exports or total farm imports on a physical volume basis, index number procedures are used. Quantities for individual commodities are weighted by a set of constant export or import prices so that variation from price changes is eliminated. Farm exports and imports also are aggregated on a value basis by simply summing the total export or import value for individual commodities.

Sometimes imports of farm products are classified on the basis of their competitiveness (substitutability) with domestically produced commodities. Imports which tend to compete directly with domestically produced products are called "competitive imports" and those which do not compete directly with local commodities are called "supplementary imports". For example, cotton imports in a country producing cotton would be classified as a competitive import, whereas coffee imported by a country not producing coffee would be classified as a supplementary import.

5. USE OF UTILIZATION DATA

Data on the utilization of farm products are used to describe year to year and long-run changes in the disposition of indigenous farm production and in domestic final consumption of products of agricultural origin. Such data are essential in measuring domestic food consumption and in evaluating the nutritional adequacy of indigenous food supplies. Farm product utilization data in conjunction with farm product supply data can be used to construct a country food balance sheet, showing the quantities of different farm products available for final food consumption. By applying appropriate estimates of the nutritive make up of various foods, estimates can be made of the total and per capita supply of nutritional elements.

Such estimates can be used in appraising the nutritional value of a country's food supply.

Farm product utilization data are an essential ingredient in studying demand structures and in estimating demand relationships for farm products. Knowledge of the components of demand for farm products and of the responsiveness of these components to such things as changes in income, population and relative price is needed in explaining past farm price and income developments, in projecting and predicting future demands for farm products and in analyzing the consequences of farm price and production policies.

5.1 *An illustration*

To illustrate the importance of knowledge about the demand relationships for analyzing the consequences of farm price policy, we might suppose that a government is considering a policy aimed at increasing the incomes of beef producers by reducing beef production. If beef production is reduced, the price of beef can be expected to rise. However, will this mean more income for beef producers if they have less beef to sell? The answer largely depends on the responsiveness of the demand for beef to a change in the price of beef. If, as a result of an increase in price, consumers of beef reduced the quantity purchased proportionally more than the increase in price, the gross income to producers from the sale of beef would fall. For example, if the quantity purchased went down 10 per cent when the price went up 5 per cent, the gross income of producers would drop about 6 per cent. On the other hand, if consumers of beef reduced the quantity purchased less than in proportion to the increase in price, gross income of beef producers would increase. For example, if the quantity purchased went down 5 per cent when the price went up 10 per cent, gross income of beef producers would rise by about 5 per cent. Thus, the effect of a program to reduce beef production on beef producers' income would depend on consumer response to a change in price -- what the economist calls the price elasticity of demand. An estimate of this response is needed to determine whether the instrument for reducing beef production is likely to increase or decrease beef producers' income and by what amount.

Utilization data also are important ingredients in planning agricultural development to meet future demands for farm commodities and for determining future adjustments in the composition or mix of farm output which will be most consistent with economic efficiency. In addition, such data are useful in analyzing market expansion potentials at home and abroad.

Questions

1. What is a "product balance sheet"? Using hypothetical data, prepare one for corn on an individual farm.
2. Distinguish between an "intermediate use" and a "final use" for farm products.
3. What is a "supplementary" import?
4. How may utilization data be used to construct a country food balance?

Chapter 6. PRICE DATA

Price data refer to the measurements of the terms on which resources (inputs) and products (outputs) are exchanged for money. These terms may be established under a variety of market arrangements ranging from pure competition to private or government monopoly. In the most competitive markets, prices are determined by bids and offers from such a large number of buyers and sellers that no individual buyer or seller can influence price. In monopolized markets, there is a single buyer or seller. By varying the quantity bought and sold, the buyer or seller can influence price. Between these extremes, markets may be characterized by different degrees of competition, depending on the number and behavior of buyers and sellers.

1. PRICING FUNCTIONS

Prices may perform a number of important functions in an economy. By indicating the cost terms on which alternative products are available and the income generating terms offered by alternative employment opportunities for resources, prices are an essential ingredient in making economic calculations involving the allocation and use of income for consumption and investment purposes and the allocation and use of resources in the production of income. Prices may be used in determining how available supplies of resources and products are to be distributed among uses and users in the economy. They may be used in determining what kinds and amounts of products should be produced and how resources should be combined in the production of each product. Price also may be used in distributing the claims to total output which are to be exercised by participants in the production process. And prices may be used in deciding how much resources should be devoted to satisfying current wants and to improve future productive capacity.

While problems of organizing and coordinating economic activities are common to all countries, the role which is accorded the price system in solving these problems varies widely. For example, prices play a much larger role and central planning a much smaller role in the United States than in the Soviet Union, although there is some evidence that the current differences are not as big as they once were. Moreover, there is wide inter-country variation in the emphasis placed on different pricing criteria, i.e. the basis for determining prices. Market clearing considerations, producer and consumer income effects and production and resource allocation considerations are given different weights in establishing prices and in formulating price policies. Some countries depend heavily on government pricing and direct controls over supplies and demands. In other countries, prices are determined largely in "free" markets and government intervention is usually limited to indirect controls and various regulatory activities such as inspection and maintaining uniform grades and standards.

2. AVAILABILITY OF PRICE INFORMATION

Likewise, the availability of price information is vastly different in various countries. In some, lack of communication and transportation as well as other factors have prevented the development of an integrated price and market system. As a result, buyers and sellers have little knowledge of prices and conditions of purchase and sale. And the production activities of large numbers of people are little affected by the organizing and coordinating influence of prices. In other countries, markets are highly organized and price and price-making information is widely distributed by both private and government agencies. As a consequence, decision-makers are better informed of the terms on which alternatives (products and employment opportunities) are made available in the economy.

The price data of primary interest in agriculture includes the prices of farm products and the prices of inputs used in farm production (e.g. fertilizer, farm machinery, credit, etc.). The relation between these two sets of prices reflects the "terms of trade" for agriculture. In many countries, agricultural price data are collected and reported by government agencies. In some, private trade groups also collect and report some kinds of agricultural price data. Index numbers of prices received by farmers and prices paid by farmers are illustrated in Table 6A.

3. USE OF AGRICULTURAL PRICE DATA

Agricultural price data have numerous descriptive and analytical use in agricultural problem solving activities. Price data describe price behavior and price behavior has important relations to problems of agricultural development, resource efficiency and income distribution.

3.1 *Formulating price expectations*

Price expectations are essential ingredients in the rational planning of production and marketing activities by individual farmers. The formulation of accurate price expectations depends on knowledge of past prices and price-making forces. Thus, price data may be used by farmers directly in formulating price expectations and by government agencies in developing price forecasts and projections for outlook reports for farmers. In price forecasting, knowledge is needed of supply and demand relationships. Price data are necessary in estimating these relationships. Of course, as pointed out earlier, knowledge of these relationships also is needed for analyzing production and consumption effects of various agricultural price, production and development policies.

3.2 *Constructing index numbers*

Price data enter into the derivation of many other kinds of agricultural estimates as well. For example, they may be used in estimating gross farm income, farm production expenses and net farm income. They also may be used in estimating land, labor and capital returns in appraising resource efficiency and alternative agricultural investment opportunities. It already has been mentioned that prices are used in the construction of index numbers of inputs and outputs in evaluating agricultural productivity, food supplies and resource adjustment needs.

Table 6A. INDEX NUMBER OF PRICE RECEIVED BY FARMERS FOR PRODUCTS AND PAID BY FARMERS FOR PRODUCTION INPUTS IN A HYPOTHETICAL COUNTRY; 1960-67

(1955-59 = 100)

Year	Price received	Price paid	Terms of trade
1960	102	104	98
1961	101	104	97
1962	98	105	93
1963	100	106	94
1964	97	107	91
1965	98	109	90
1966	99	108	92
1967	101	109	93

[1] Ratio of price received to price paid.

The usefulness of price data for some agricultural problem solving activities depends on certain characteristics of the prices measured by the data. For example, the use of prices as weights in the construction of index numbers of inputs and outputs rests on the assumptions that input prices are proportional to productivity and that output prices are proportional to utility. Insofar as these assumptions fail to hold, the index measurements of inputs and outputs will be distorted. Or, if certain pricing policies result in prices which do not reflect the real values of commodities, use of such prices in estimating resource earnings may lead to conclusions about resource efficiency and investment opportunities which are not valid.

Questions

1. List some of the functions of prices.
2. Discuss the uses of agricultural price data.

Chapter 7. FARM INCOME AND WEALTH DATA

Income is a flow concept relating to the results of productive activity over a period of time. It represents what is available for satisfying current wants without affecting future productive capacity. While it represents what is available for satisfying current wants, this does not mean that the whole of income must be used this way. A part may be used to increase future capacity to satisfy wants through the process of savings and investment. The concept can be applied to an individual or group of individuals (personal income), to a production unit or group of production units (firm or industry income) and to the economy as a whole (national or social income).

Wealth is a stock concept relating to the collection of income producing resources at a given point in time. Additions to wealth are made by devoting part of income to investment activities which increase the future collection of income producing resources. Whereas the concept of wealth is applicable to all income producing resources, measurements of wealth frequently are limited to non-human (i.e. physical) resources.

1. FARM INCOME DATA

Farm income may be defined as the net value of final output produced by resources engaged in farm production. It also may be defined as the sum of the payments to or claims by farm resources for contributions to farm production. These definitions of farm income come to much the same thing. However, these definitions need to be distinguished from various definitions of the income of farm people. Farmers and members of their families may obtain income from nonfarm sources. This has become a rather frequent occurrence in some of the more developed countries. They might hold a nonfarm job or have investments in nonfarm properties. In either case, the income of farm people may come partly from farm sources and partly from nonfarm sources. Likewise, not all the resources generating income in farm production activities may be owned by farm people. Some may be owned by nonfarm people so that a part of the income produced in farming is claimed by nonfarm owners of resources. It is only when all the resources used in producing farm income are owned by farm people and when all the resources owned by farm people are devoted to farm production activities that it becomes unnecessary to distinguish between farm income and the income of farm people.

1.1 Estimating farm income

Estimates of farm income typically are derived from data on production expenses and from data on farm revenues or receipts. When income is estimated on an accrual basis, account is taken of changes in inventories of resources and semi-finished products. Farm revenues may include sales of products, value of products used in the farm household, rental value of the farm dwelling, government payments under agricultural income and development programs and the value of additions to farm inventories. Production expenses may include outlays for such items as seed, fertilizer, water, work stock, machinery, pesticides, fuel and transportation. They also include an allowance for depreciation on fixed capital and the value of decreases in farm inventories.

Estimates of farm income on individual farms usually are made from revenue and expense data collected by personal interview with farmers in a census or sample survey. If the sample of farms is appropriately designed, aggregate estimates of farm income for an area or region can be prepared by use of a "blowup" procedure. If the data are based on a complete census, aggregate estimates can be derived by simply summing individual farm estimates.

1.2 *Sources of data*

Because of the high cost of collecting individual farm data, aggregate estimates of production expenses, revenues and net farm income frequently are based on data from a combination of sources. Cost data may be estimated from data on input quantities and prices. For example, farm consumption of fertilizer may be estimated as a residual from inventory, production and foreign trade data. An average price might be estimated from available price data and used in estimating production expense for fertilizer. Receipts from sales may be estimated from data on production, inventories, utilization and prices. In some cases, home used quantities might be estimated from a combination of sample data and census data.

In many countries, census of agriculture provides the most comprehensive source of data for estimating aggregate farm income and other variables. However, a census may be taken only every 5 or 10 years. Thus, the data soon get out of date. Consequently, in some countries more frequent surveys of a small number of farms are made and the data generated by these surveys are linked to census data, sometimes by regression analysis, for the purpose of providing a basis for national or regional estimates which cannot be made directly because of the limited scope of the farm survey. This procedure has been used extensively in making crop and livestock estimates in the United States.

1.3 *Income distribution*

Although reasonably accurate estimates of aggregate farm income may be prepared without detailed production expense and revenue data from a complete enumeration or representative sample of individual farms, this is not the case in estimating the distribution of farm income among farm families. If accurate estimates of farm income distribution are to be made, production expense and revenue data from all farms or a representative sample of the population of farms are essential. But the cost of generating such data on a country-wide basis is very high. Even in the most developed countries, data generally are not available for making periodic estimates of the distribution of farm income. As a result, there is very little quantitative information in these countries for evaluating the distribution of farm income and for analyzing the effects of government policies on the degree of income inequality in agriculture.

To illustrate the kinds of aggregate farm income data that can be prepared, selected estimates for the United States are presented in Table 7A. It should be noted that these estimates apply to the income of farm operators from farming, i.e. the income earned by resources owned by farm operators. In computing operator's farm income, payments for hired labor and the net rent to nonfarm landlords are deducted as production expenses. If these items are added back in, an estimate of net farm income can be prepared, i.e. income to the land, labor and capital resources engaged in farming.

2. FARM WEALTH DATA

Farm wealth may be defined as the total value of the stock or inventory of farm income producing resources on a particular date. Included in this stock would be human capital, land and various kinds of non-human capital such as livestock, machinery, stored crops, tools and farm buildings. It has been common practice, however, to exclude human capital in the measurement of farm wealth.

2.1 *Relation of wealth and income*

The value of the stock of farm income producing resources is related to its income producing capacity and the rate of interest. This can be seen most readily in the case of land yielding a permanent flow of annual net rent. Suppose this flow amounted to \$10.00 per year and the rate of interest were 5 per cent. The income producing value of this land then would be $\frac{\$10}{.05}$ or \$200. The price of the permanent flow of income from this land of \$10 per year would be \$200.

2.2 *Measuring farm wealth*

Estimates of farm wealth may be prepared from data on farming inputs and appropriate price data. Ideally, input data measure the flow of resource services over a period of time, whereas for estimating wealth it is

Table 7A. OPERATOR INCOME FROM FARMING FOR THE UNITED STATES: 1950, 1960, and 1964

(In millions of dollars)

Subject	1950	1960	1964
Revenue	33,083	38,257	41,355
Receipts from marketings	28,461	33,999	36,899
Government payments	283	693	2,169
Value of home used products	2,063	1,248	937
Rental value of dwellings	1,464	1,975	2,185
Net inventory increase	812	342	-835
Production expense	19,410	26,242	29,249
Feed purchased	3,283	4,911	5,964
Livestock purchased	2,004	2,500	2,408
Seed purchased	518	509	555
Fertilizer and lime	975	1,305	1,678
Repair and machine operation	2,975	3,957	3,939
Hired labor	2,811	2,864	2,708
Depreciation on farm capital	2,665	4,237	4,655
Taxes on farm property	919	1,500	1,834
Interest on real estate debt	264	627	948
Net rent to landlords	1,233	1,007	1,094
Miscellaneous operating expenses	1,763	2,825	3,466
Operator net farm income	13,673	12,015	12,106

Source: United States Department of Agriculture, Farm Income Situation, July 1965.

necessary to measure the stock of resources producing the flow of services. Since the size of the flow is related to the size of the stock, it is usually possible to measure one from the other.

As in the case of income, it is necessary to distinguish between farm wealth and the wealth of farm people. Farm wealth refers to the value of the income-producing resources used in farming, whereas the wealth of farm people refers to the income producing resources owned by farm people. Not all farm wealth may be owned by farm people and farm people may own various kinds of nonfarm wealth. For some purposes, ownership of consumer durables such as household furnishings and equipment may be included in the wealth of farm people. Typically, the wealth of farm people consists mostly of farm wealth and most farm wealth is owned by farm people.

2.3 Debts

Ownership of farm wealth may be unencumbered or encumbered with debt. In most countries, the debts of farm people are a claim against their wealth. Some of the debt may represent a claim against specific forms of wealth (e.g. a mortgage against farm real estate). Other debt may be a claim against their wealth in general. It is common accounting practice to deduct debt claims from wealth (assets) in estimating personal wealth ownership. The residual is termed "equity" or "net worth".

Data on debts of farm people and on debt claims against specific forms of farm wealth may be collected from borrowers in a census or sample survey, or it may be obtained from lending agencies and other suppliers of credit. Data on assets and liabilities usually are expressed in terms of money and apply to the beginning or end of the accounting year.

2.4 *Balance sheet of agriculture*

In the United States, estimates of agricultural assets and liabilities have been prepared for constructing a "balance sheet of agriculture". Assets include the physical resources defined as farm wealth, the value of household furnishings and farmer owned financial assets such as bank deposits and currency, stocks and bonds and investments in cooperatives. Liabilities include real estate debt, chattel debt and unsecured loans and open accounts. The balancing item is called "proprietors' equity" and represents the difference between total assets and total liabilities. "Proprietors' equity", however, is not strictly a measure of either farm wealth or the wealth of farm people. It is a mixture of the financial net worth of farm people and the equity held by nonfarm people in farming assets. The "balance sheet of agriculture" in the United States is presented in Table 7B.

3. USE OF FARM INCOME AND WEALTH DATA

Data on farm income and wealth probably provides the best overall measures of the economic position and performance of the farm industry. When appropriate account is taken of the quantity and quality of farming resources, farm income data can be used to analyze and appraise the income producing efficiency of agriculture in relation to that of other industries. Data on farm wealth and on the production, distribution and utilization of farm income are essential in identifying, evaluating and diagnosing the welfare problems of agriculture and in formulating and appraising policies to deal with these problems. Such data also are useful for analyzing problems of agricultural investment in designing agricultural development policies.

3.1 *Income programs*

Farm income and wealth data may be used in appraising the need for and effects of income and wealth redistribution programs, including land reform. In many countries,

Table 7B. FINANCIAL BALANCE SHEET OF AGRICULTURE FOR THE UNITED STATES: 1 JANUARY, 1965

(In billions of dollars)

Assets		Liabilities	
Real estate	159.4	Real estate debt	18.9
Livestock	14.4	Commodity credit corporation debt	1.5
Machinery and vehicles	25.7	Debt owed to financial institutions	10.0
Crops in storage	8.9	Other debt	7.1
Household furnishings and equipment	8.7		
Deposits and currency	9.6		
Savings bonds	4.2	Sub total	37.5
Investments in cooperatives	7.2	Proprietor's equities	200.6
Total	238.1	Total	238.1

Source: United States Department of Agriculture, Agricultural Statistics, 1966.

rising land values have pointed up the need for better wealth data in assessing the economic position of agricultural land owners. Appreciation of farm land can be a significant source of wealth accumulation over and above savings out of current income. And the gains from this source need to be taken into account in appraising the economic position of farm land owners.

3.2 *Caution in interpretations of income and wealth data*

Because of conceptual and measurement difficulties, extreme care must be exercised in using available income and wealth data. For example, comparison of recent estimates of the per capita income of farm people and the per capita income of nonfarm people in many countries shows a wide difference in favor of nonfarm people. Yet, it is not always clear how much of the difference is real and how much is fictitious due to poor quality data. In some instances, differences arise because the data do not include all sources of income. Differences also arise because of variation in the pricing of certain income and expense items. In other instances, differential advantages relating to application of tax laws and to cost of living differences are not properly taken into account. Thus, even in countries where farm income estimates are available, there is an urgent need to improve the data. Of course, in many countries there are few if any time-series estimates of farm income and wealth.

Questions

1. Distinguish between income and wealth.
2. What data are needed in estimating farm income?
3. Are detail expense and revenue data for individual farms needed in estimating the distribution of total farm income? Explain.
4. How are farm wealth and farm income related?
5. What is a "balance sheet of Agriculture"?
6. What are some of the sources of measurement errors in estimating farm income?

Chapter 8. FARM ORGANIZATIONAL AND RELATED INSTITUTIONAL DATA

1. ORGANIZATIONAL DATA

The farm industry is made up of individual farm production units (farms or holdings) which plan and conduct farming activities. The methods and arrangements for planning and coordinating farm production activities give the industry distinctive organizational features. Organizational data provide information about these features. Some relate to the way resources are administered within individual production units; others relate to the number and make-up of production units and the arrangements for coordinating and achieving consistent decision-making among units.

1.1 Organization

The organization of farming activities varies widely over the world. Perhaps the most common organization is where farm production activities are built around a labor supply provided by the farm family and farming activities are closely linked to household activities. Decision-making responsibility usually is in the hands of the head of the family. But farming activities also are organized under other arrangements, including the private corporation, cooperative, collective and state farm. It is not uncommon to find more than one kind of arrangement in particular countries, although the mix of arrangements may show wide variation among countries.

1.2 Coordination

There are wide inter-country differences not only in the arrangements used in administering resources within production units but also in the arrangements for coordinating the farming activities of different units. Some countries emphasize decentralized organization of economic activities and accord the price system a major role in coordinating the activities of individual production units. Others emphasize centralized organization and depended heavily on the techniques of central planning for coordination. Associated with these differences are differences in the methods and criteria for establishing incentives and for distributing rewards.

The organizational characteristics of the agriculture of particular countries generally reflect both the state of organizational knowledge which sets limits on organizational alternatives and the preferences of the people making up the power structure for the consequences offered by alternative organizational arrangements. These preferences, in turn, reflect the values attached to numerous economic, political and sociological considerations. Agricultural organization is closely associated with institutional characteristics, particularly those relating to the ownership and control of resources and the price and market system.

1.3 Organization information

Much information on the organization of agriculture may be obtained from data on the number and size of production units, the mix of resources used, the composition of output, and the ownership and control of farming resources. However, a full understanding of agricultural organization requires information on the decision-making process on individual production units and on the methods for coordinating farming activities, including the price and market system and the process of government or central decision-making.

Information is needed on the techniques of control, including the incentive and reward system and the use of coercive power, the programming of task performance, the methods of resolving conflict and the procedures for handling uncertainty. Much of this information is hard to quantify and difficult to collect. It usually has to be obtained by "in depth" interviewing methods that are relatively costly. Such information, however, can be exceedingly useful in analyzing and evaluating the cost effectiveness of alternative organizational arrangements in solving agricultural efficiency, development and income problems.

2. FARM RELATED INSTITUTIONAL DATA

Under this heading are included data on the institutions which service farm production units and households. These institutions include the industries involved in the marketing of farm products, the businesses providing reproducible physical inputs (fertilizer, pesticides, etc.) in farming, the establishments supplying consumer goods for farm households and the institutions that generate and disseminate new agricultural technological and management knowledge. In general, these institutions influence the performance of the farming sector primarily by affecting (a) the availability of goods and services used in farm production and consumption and (b) the prices received and paid by farmers. They may be owned and operated as government enterprises or as private businesses.

To analyze the performance of these establishments and the impact they have on the farm industry, the same kinds of data are needed for these institutions as have been discussed for agriculture. This includes data on inputs and outputs, prices, utilization, and organization. Such data usually are not collected in a census or sample survey of agriculture but may be obtained by the application of similar procedures to the nonfarm part of the agri-business economy. Insofar as the establishments are government enterprises (e.g. the generation and dissemination of farm technological and management information) needed data may be available from government reports.

2.1 *Role in agricultural development*

Some of these establishments play a unique role in the process of agricultural development. This is particularly true of those involved in the generation and dissemination of new farm technological and management knowledge and in the production of new, more productive reproducible farming inputs. Consequently, the analysis and evaluation of the performance of these establishments and the relationships between their performance and the productivity of agricultural resources are especially important in the design of optimal agricultural development policies.

3. MISCELLANEOUS DATA

Some of the data that are important in agricultural problem solving activities relate to general economic variables. For example, in estimating agricultural demand relationships, data are needed on population and on the level and distribution of national income. For analyzing the supply of agricultural labor and farm-nonfarm migrations, measurements are needed of the strength of the nonfarm demand for labor. Estimates of the rate of nonagricultural unemployment are frequently used for this purpose. However, where underemployment of labor is widespread, this measurement has serious limitations.

Data on the characteristics (e.g. number, age, sex, education, etc.) of the farm population are needed for analyzing agricultural income and welfare problems, for evaluating the quality of the farm labor supply and for describing and analyzing the adjustment of farm labor and population to the impact of the forces of economic growth.

Data on the amount and quality of educational services available in rural areas, the participation of farm youth in educational opportunities and the earnings of people with different educational and occupational backgrounds are useful in analyzing the returns from investment in the education of farm people and the contributions which these investments make to agricultural development.

Data on the operations of government farm programs are needed for analyzing program effects and for appraising their contributions in improving farm industry performance. These data may be obtained from reports of program administrative agencies. However, much of the data needed for this purpose may have to be collected from farmers by use of sampling techniques.

Questions

1. What are "organizational data"?
2. How do marketing institutions influence the farming sector?
3. What kinds of general economic data are needed in estimating agricultural demand relationships?

Chapter 9. DATA FOR INDIVIDUAL FARM PLANNING

In this section, we will discuss the data needs of the farmer in planning the organization and operation of the individual farm production unit. For this purpose, it is assumed that the objective is to obtain the largest possible income from the business, i.e. the largest excess of revenue over production expenses.

1. CONTROLLABLE AND NON-CONTROLLABLE FACTORS

Some of the factors which determine the amount of income will be outside the manager's sphere of control. Others will be subject to some degree of influence. These may be viewed as the farm planning variables. Of course, some factors that may be beyond the manager's control in the short-run may be subject to control over a longer period. This complicates the planning process and makes it necessary to specify a finite planning horizon.

Among the factors that are likely to be outside the manager's control in both the short-run and long-run are the prices at which he sells his products and the prices which he pays for purchased inputs. Also in this group will be weather conditions and the general stock of agricultural technical knowledge. Essentially, these are the external conditions to which the manager adapts his farming operation. Since these conditions change over time, farm plans must be revised and kept up to date if income is to approach the maximum level continuously.

Among the factors which are likely to be subject to some degree of control, particularly in a long-run context, will be the overall size of the business, the mix of products produced and the combination of resources used in the production of each product. He also is likely to have some control over where he buys his purchased inputs and where he sells his products, although sometimes this may not be true.

The factors over which he has some control present the possibility of developing alternative plans which differ with respect to size of business, product mix and resource combinations and so forth. Given the conditions over which he has no control, each possible plan generally will produce a different level of income. The planning problem is to identify and select the plan which is expected to offer the largest possible income.

2. FARM PLANNING PROCEDURES

Procedures have been developed to help solve this planning problem. One such procedure is called farm budgeting. In applying this procedure, one starts with the existing organization of the farm business or develops an initial tentative plan which specifies a set of feasible characteristics for the farm's operation. In either case, there will be an estimate of the level of income obtainable. Adjustments are then made in the characteristics of the business and estimates are prepared of the revenue and cost effects of these adjustments. Each set of adjustments gives a new plan with a new estimate of income. If a large number of plans are developed, the chances are good that the income maximizing plan will be among them. However, this requires much labor and may be quite expensive.

In recent years, a more systematic procedure, called mathematical programming, has been developed which can be used in identifying the income maximizing plan. Because of the large number of computations involved in estimating the revenue and cost effects of many alternative plans, this procedure is used with high speed computers. Inasmuch as this procedure is more systematic, there is less likelihood of failure to identify the optimal plan. For this reason, most farm management analysts prefer it to budgeting. However, there are circumstances under which budgeting procedures may have to be used. Even under circumstances where programming can be used, it may not always be the most efficient procedure.

3. FARM ADJUSTMENT POSSIBILITIES

There are three major categories of changes that might be made in production plans: (1) more or less resources (total input) may be devoted to production, i.e. the overall size of the farm business may be expanded or contracted, (2) the input of some resources may be increased and the input of other resources may be decreased, i.e. the combination of resources used in production may be adjusted and (3) the outputs of some products may be increased and the outputs of other products may be decreased, i.e. the mix of products or the composition of output may be changed. Of course, two or more of these kinds of adjustments might be made at the same time.

3.1 *Input-output effects*

Each possible adjustment in plans will have input effects, output effects or effects on both inputs and outputs. A pure substitution of one kind of input for another kind of input, with outputs and other inputs remaining the same, will have input effects but no output effects. Likewise, a pure substitution of one product for another product, with inputs and other outputs remaining the same, will have output effects but no input effects. Typically, most adjustments are not of the pure type, however.

3.2 *Cost and revenue effects*

As a result of the effects on inputs or outputs or both, each possible adjustment will affect income by changing revenue (output quantities times product prices) or production expense (purchased input quantities times prices paid) or both. If an adjustment in plans increases revenue more than it increases production expense or if it reduces revenue less than it reduces production expense, income will rise. On the other hand, if production expense increases more than revenue or if revenue decreases more than production expense, the adjustment in plans will reduce income. In line with his objective of maximizing income, the manager wants to identify and implement those adjustments that promise to increase income.

4. DATA NEEDS

Both budgeting and programming procedure require essentially the same kinds of data. Unless sufficient data of high quality are available, a poor solution is likely to result in each case. The data needs may be classified into three broad categories: (a) resource data, (b) input-output data and (c) price data.

4.1 *Resource data*

The farmer operates under some resource limitation. In general, this limitation is fixed by the amount of resources currently under his control and the additional resources he may control by lease or purchase if they can be profitably used. The resource limitation places an upper limit on the size of the farm business as measured by total input. These resources might include land, family labor, various kinds of reproducible physical inputs such as breeding and work stock, machinery and farm buildings, finished and semi-finished farm products, cash and claims to nonfarm wealth and borrowing capacity.

For planning purposes, the manager needs a detailed inventory of these resources, showing the amounts of each and significant qualitative attributes. If there are time limitations on the availability of any resources (e.g. time when a son will be available for work on the farm because of school), these need to be identified. Also, if there are prior claims on some of the resources (e.g. a claim on cash for farm household expenses), these should be noted. Such an inventory will provide the farmer with some of the data needed for planning. It also gives him a picture of his "economic base" for producing income.

4.2 *Input-output data*

If the farm operator is to identify and implement those adjustments that promise to increase income, he has to be able to estimate the input and output effects of each possible adjustment. And this requires information about input-output relationships. Data on input-output relationships show the response of outputs to changes in inputs. They also indicate substitution rates between products and between inputs. For example, they show the amount of labor that might be saved without affecting output by using an additional unit of capital. And they show how much beef output has to be sacrificed, other things remaining the same, to free enough resources to produce an additional unit of pork.

Good information on input-output relationships is difficult to obtain. Much of the input-output data used in farm planning is based on the experience of individual farmers or on experimental evidence obtained in agronomic or animal experiments conducted by agricultural research institutions. Frequently, available input-output data only show the average input per unit of output or the average output per unit of input. If input-output relationships are not linear, use of average product data may result in poor estimates of input and output effects.

Frequently, the farmer can supplement data from other sources with information obtained from his own experience in developing his judgments of the input and output effects of various possible adjustments. However, if agricultural technology should be advancing rapidly, many new kinds of farming inputs will become available. Before adoption, he will have had no experience with these inputs. Consequently, he then will have to depend on information from other sources in forming his judgments.

His estimates of the input-output effects will be subject to error. Various unforeseen contingencies may result in larger or smaller effects than he anticipates. For example, his crop yield estimates may be based on average weather. If poorer or better than average weather should occur, the output effects will be different. Or, his input-output expectation in the hog enterprise may be based on an absence of disease. If a disease outbreak occurs, his hog output will be less than he estimated. Consequently, he may wish to make some allowance for these kinds of uncertainties in estimating input and output effects.

Because of the important role of technological information in farm planning, efforts to improve data on input-output relationships are likely to have a relatively high payoff. This is particularly true in countries where only fragmentary input-output data are available and available data are of low quality.

4.3 *Price data*

To translate the input and output effects of various adjustment possibilities into revenue and expense effects, the farmer needs data on product prices and the prices of purchased inputs. Of course, the prices that are relevant for developing plans are future prices -- the prices that will exist when he sells his products and buys his purchased inputs. Thus, he must formulate a set of price expectations.

His price expectations might be based on current prices or past prices. He also might base them on published price forecasts or on an analysis of past price-making forces and projections of the more significant price determining variables. In any case, data on current and past prices are needed.

Whatever basis is used in formulating his price expectations, he is likely to recognize that prices may turn out to be higher or lower than those expected as most probable. In other words, he is likely to view his price expectations as being subject to error. Thus, he may want to make some allowance for price uncertainty in applying his price expectations to the estimated input and output effects in arriving at estimates of revenue and expense effects.

In countries where government policies are designed to support farm prices, the manager's task of formulating price expectations may be lightened appreciably. These policies may make it easier to arrive at an estimate of a most probable price. By reducing the possible range of price variability, they also may decrease price uncertainty and help to firm up the manager's production plans.

In considering price expectations as necessary ingredients in developing and selecting an income maximizing plan, it has been assumed that purchased inputs are available at the prices expected and that farm products can be sold at the prices expected. In most of the developed countries of the world, this usually is a realistic assumption. But in some of the less developed countries, it frequently is not realistic.

Because of supply and transportation conditions, purchased inputs may not always be available in local markets at quoted prices. Moreover, local buyers may not always be willing to take quantities offered by producers at quoted prices because of handling problems. And, of course, in some areas there may be no local markets or price quotations and no means of transporting farm products and inputs to and from other markets. In such a situation, farm planning will tend to be geared to local or household needs on a self-sufficient basis. The income gains from broader specialization and the adoption of new more productive farming inputs will not be realizable.

Questions

1. Enumerate the factors which influence the income of the individual farm and classify each according to controlability by the individual farmer.
2. What are "farm adjustment possibilities" and how do they relate to the classification in question 1?
3. What kinds of data are needed for individual farm planning?
4. Distinguish between "budgeting" and "programming" as farm planning procedures.

Chapter 10. DATA FOR AGRICULTURAL DEVELOPMENT PLANNING

Agricultural development may be defined as the process of increasing agriculture's contribution to national income. An increase in agriculture's contribution to national income may take the form of a larger output of farm products and/or a release of farming resources for the production of non-agricultural goods and services. The particular forms of the increase largely depend on demand considerations.

Broadly viewed, there are two approaches to the problem of agricultural development. Since these approaches are not mutually exclusive, there is an important question of the appropriate mix for an optimal development strategy. This mix is likely to vary with the stage of a country's development.

1. AGRICULTURAL EFFICIENCY APPROACH

One approach focuses on the opportunities to tighten the efficiency of the agricultural sector in allocating and utilizing currently available resources and products. Here the idea is to squeeze more income out of existing agricultural resources and products by doing a better job of managing their use. The test of efficient management is based on the principle of equalizing the advantages (return or value) obtained at the marginal in different uses for products and resources. For example, if an additional unit of capital can produce an output in X employment which is twice as valuable as the output it can produce in Y employment, the total value of output (income) may be increased by shifting capital from Y to X. Or, to take another example, if an additional unit of wheat has a value in A location which is greater than its value in B location and if this difference exceeds the value of the resources needed to move it from B to A, the value of the wheat crop may be increased by moving some of it from B to A. By reallocating resources (products) from low return (value) uses to high return (value) uses, total return (value of output) may be increased and the management of resources and products may be made more efficient.

1.1 *Inefficiency as a source of economic growth*

Elimination of inefficiencies in the allocation and use of agricultural resources and products can give a "one shot" boost in national income. Inefficiencies, however, are a potential source of additional income only as long as they persist. Once they are removed (assuming they do not reoccur), there can be no additional income gain from this source. This would be the situation in a stationary economy (one not subject to permanent growth forces) which had achieved an efficient allocation and use of resources. National income in such an economy would reach a maximum, based on existing resources and technical knowledge, but it would not exhibit growth. Per capita income could be high or low, depending on the amount of resources, resource productivity and population. But all possible income would have been squeezed out of available resources and products.

In an economy subject to permanent growth forces, inefficiencies in the allocation and use of existing resources and products are constantly being generated so there is a continuous stream of opportunities to tighten efficiency. If the institutional arrangements for guiding and encouraging resource reallocations which eliminate inefficiences are highly effective, and if other conditions for adaptation are reasonably well satisfied, there may be relatively little inefficiency even though permanent growth forces have been strong. On the other hand, inefficiencies may be widespread in an economy subject to weak growth forces if the conditions for resource adjustment are not well satisfied.

2. AGRICULTURAL INVESTMENT APPROACH

The second approach focuses on the process of increasing the quantity and quality of agricultural resources by investment, i.e. devoting resources to upgrading the level of technical and management knowhow, to developing and supplying new, more productive forms of reproducible physical inputs and to expanding the input of existing kinds of farming resources. Investment constitutes the main permanent growth force in an economy and agricultural investment is the principal vehicle for achieving sustained agricultural development.

2.1 *Kinds of agricultural investment*

Agricultural investment resources may be devoted to increasing productive capacity on farms, in the farm input supply sector and in the farm marketing sector (transport, storage, processing and retail distribution). In broad terms investment alternatives on farms include (a) old (existing) forms of reproducible farming inputs, including capital imbedded in land, (b) new, more productive forms of reproducible physical inputs (assuming they are available) and (c) the technical and management skills of farmers.

In the farm input supplying sector, investment may be geared to producing additional quantities of existing forms of reproducible farming inputs and/or reducing the costs of supplying these inputs. Investment may be made in research and development activities designed to create new, more productive farming inputs (e.g. better seed, more effective fertilizers and improved pesticides) and to produce these at the lowest possible supply prices. It also may be made in generating and disseminating knowledge relating to improvements in agricultural technological and management practices.

In the agricultural marketing sector, investment resources may be devoted to producing more and lower cost facilities for storing, transporting and processing agricultural products. They also may be used for improving the quality of existing farm products and for developing new processed products of agricultural origin.

2.2 Contribution of agricultural investment

The contribution of investment to agricultural development depends heavily on the level of agricultural investment -- how much resources in general are devoted to increasing future agricultural productive capacity, and on how these investment resources are allocated among and utilized within alternative agricultural investment outlets. This is largely a matter of the costs and returns associated with agricultural and non-agricultural investment opportunities and with alternative investment opportunities within agriculture. To maximize the permanent income stream from a given total investment, each investment outlet should absorb investment resources until the expected additional return falls below the expected additional opportunity cost -- the expected net return from the next best investment outlet.

3. DATA NEEDS FOR THE EFFICIENCY APPROACH

The potential agricultural development payoffs in the efficiency approach depend on how badly the agricultural sector is currently allocating and utilizing available products and resources. Thus, the identification, analysis and evaluation of inefficiencies is a necessary step in realizing the income gains from this source.

For purposes of identifying resource and product inefficiencies, data are needed that will permit estimates of the returns to agricultural resources and the values of farm products in alternative uses, locations and time periods. This includes data on the quality and quantities of inputs, outputs, product prices and purchased input prices. For analyzing the "causes" of persistent inefficiencies, data are needed on these items as well as on the factors which prevent the equalization of resource returns and product values in different uses, locations and time periods. This might include information on the knowledge possessed by producers relating to the terms on which income may be earned in alternative employments for resources, on the availability of employment alternatives and restrictions on entry and on preferences and the costs associated with resource adjustment.

In evaluating the potential income gains from removing agricultural inefficiencies, data are needed which will permit estimates of the return relationships for resources and the demand relationships for products. Data also are needed for estimating the costs that are likely to be incurred in eliminating the inefficiencies. Again, this includes data on inputs, outputs and prices, both for farm production and for the activities designed to remove the inefficiencies. The nature of these activities would depend on the "causes" of the inefficiencies.

3.1 *Illustration of produce-use inefficiency*

To illustrate the kinds of data needed in identifying and analyzing agricultural inefficiencies, we will use two examples, one illustrating an inefficiency in the use of a product (wheat) over time and the other illustrating an inefficiency in the composition of farm output (quantities of wheat and potatoes produced).

For the first example, it is hypothesized that the output of wheat in Country A has not been used efficiently during the crop year. The criterion for an efficient seasonal use of wheat is that the distribution of consumption during the year results in a seasonal price advance which just tends to cover the (incremental) cost of carrying wheat from one harvest period to the next. To examine this hypothesis, monthly time series data are needed on the prices of wheat and on the cost of storing wheat. Data on monthly consumption of wheat also would be helpful.

Suppose that the necessary data are available and that they indicate (a) that the seasonal demand for wheat is stable, i.e. at a constant price about the same amount of wheat will be consumed each month of the crop year, although the quantity demanded may change from year to year, (b) that the average seasonal advance in price is about 50 cents per bushel and (c) that the cost of storing wheat from one harvest to the next is about 15 cents per bushel, including loss from rodents and so forth. On the basis of these facts, there is strong support for accepting the hypothesis as true. The evidence indicates that additional income can be generated by storing more wheat immediately after harvest for consumption later on in the season, since the price advance typically is large enough to more than cover the cost of storage. If additional storage facilities currently are not available, it would be economic to construct them at the cost of 15 cents per bushel.

The size of the income gain from increased seasonal storage would depend on the responsiveness of seasonal demand to a change in price. If more wheat moves into storage after harvest, the increase in inventory demand will tend to raise the price at that time. If more wheat moves out of storage and into consumption later on in the season, the price at that time will tend to be lowered. Now if a small shift in the time distribution of consumption results in a relatively large drop in the seasonal price advance, the income gain from more storage will tend to be relatively small. On the other hand, if it takes a large shift to make the price advance equal to the cost of storage, the income gain will tend to be relatively large. In evaluating this potential income gain and the amount of storage facilities needed to realize the gain, data are required that will permit estimates of the seasonal demand for wheat and the relationship between cost and volume in providing storage facilities.

3.2 *Illustration of a production inefficiency*

For the second example, it is hypothesized that there has been an inefficiency in the relative amounts (mix) of wheat and potatoes produced. The criterion for an efficient product mix is approximate equality in returns to resources devoted to the production of different farm products. To examine this hypothesis, data are needed which will permit estimates of the (marginal) returns to resources in the production of both wheat and potatoes. This includes data on inputs, outputs, product prices and production costs.

Suppose that these data are available and that good estimates are made of resource returns in potatoes and wheat production. Also suppose that the evidence clearly shows a large and persistent difference in resource returns in favor of potatoes. It is concluded then that there has been an inefficiency in the composition of farm output. But now it has to be decided whether it is an inefficiency that is worth while to remove. This will depend partly on how much it will cost. To estimate this, it is first necessary to determine the "causes" of the inefficiency. If income earning opportunities in potato production have been substantially better than in wheat production as the evidence indicates, why haven't producers cut down on wheat production and expanded potato production? This calls for an analysis of producer production response and requires data on producer goals and expectations concerning prices, input-output relationships, costs, etc.

Suppose that such an analysis is made and that it is determined that the cause is lack of information about input-output relationships on the part of many wheat producers. Then it would be necessary to estimate what it will cost to provide these producers with the necessary information. This may require data on inputs, outputs and prices for information dissemination activities. With knowledge of the resource return relationships in wheat and potato production and an estimate of the cost of providing the needed information, it would be possible to determine the income gains that might accompany the removal of some or all of the inefficiency in the product mix.

In these examples, we have assumed that all of the effects of the inefficiencies and their removal have been included in the items mentioned as benefits (i.e. income gains) and costs. However, there may be other benefits and costs associated with the "before and after situations". If this were true, these would need to be taken into account in the final determination of appropriate policy.

4. DATA NEEDS FOR THE INVESTMENT APPROACH

The critical steps in the investment approach to agricultural development include (a) identification of alternative investment opportunities (projects), (b) estimation of expected costs and returns, (c) selection of projects and implementation of investment plans and (d) evaluation of results and modification of plans to keep them up to date with changing conditions. Much descriptive and analytical information is needed for efficient agricultural investment planning. As a result, data needs are extensive and include most of the items referred to earlier. Perhaps the most important and also the most difficult aspect of investment policy is the estimation of expected costs and returns. In discussing data needs, we will concentrate attention on this aspect.

4.1 Investment problem

As indicated earlier, there are many outlets for agricultural investment expenditures. And each of these outlets may absorb different amounts and kinds of investment resources. Consequently, a large number of alternative investment plans are possible. The problem is to identify and select the plan which offers the largest income gain for the agricultural investment resources available. This is an extremely difficult problem to solve, partly because of the large number of considerations that need to be taken into account and partly because investment is oriented to the future with its many uncertainties.

Investments in agriculture may be made by private individuals and firms or by government. The relative importance of private and government investments in agriculture varies from country to country. In some countries, agricultural investment is mostly private, whereas in other countries, it is mostly government. However, the nature of the problem of evaluating alternative investment opportunities is essentially the same in each case. Likewise, the kinds of data needed in making cost and return estimates are similar.

4.2 *Nature of investment activity*

The essence of investment activity is the use of resources to increase future productive capacity. For example, when a dam for irrigation is constructed the future supply of water for irrigation will be increased. Application of the additional water in crop production presumably will increase future annual crop output over the life of the dam. The increased crop output will have a certain value depending on future crop prices. In producing the additional crop output, other costs will be incurred for perhaps fertilizer, harvesting, etc. To these costs must be added the annual operating costs and depreciation charge for the dam. Thus, there will be a stream of future annual revenues and a stream of future annual costs. The rate of return over cost will be the rate of discount which makes the present value of the net returns over the life of the dam just equal to the cost of constructing the dam.[1]

4.3 *Estimating expected return*

In estimating the expected rate of return over cost from a given agricultural investment, it is necessary to predict or project the future output effects, future price effects, future input effects and the life of the asset created by the investment. If investments involve the creation of additional quantities of old kinds of assets, input and output data from previous investment experience might be used in projecting input and output effects. However, if the investment involves the creation of a new kind of asset, there will be no previous experience of a strictly comparable nature on which to base estimates of input and output effects. In some cases, it may be possible to draw an investment experience with somewhat similar kinds of assets in other countries. In other cases, experimental evidence and evidence from test applications may be used in making input and output projections.

The valuation of the output increases from agricultural investment also presents some difficulties. In projecting the prices to be used in estimating expected revenue, account must be taken of other developments which will influence future demands for farm products and future supplies of farm products. On the demand side, this might include such things as population, per capita income, distribution of income and prices of competitive products. On the supply side, it might include prices and availability of purchased inputs, improvements in farming practices and nonfarm demands for nonpurchased farming inputs. In addition, the price effects of the investment being considered need to be taken into

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[1] Suppose that the dam costs C dollars to construct and that it has a life of n years. If we let R equal the annual net return (revenue less cost), the rate of return over cost (r) can be calculated as follows:

$$C = \frac{R_1}{(1+r)^1} + \frac{R_2}{(1+r)^2} + \ldots \frac{R_n}{(1+r)^n}$$

account. These effects partly depend on how fully the farm industry adjusts to the impact of the investment. In some cases, an investment which under conditions of full adjustment may provide a large positive return may under conditions of partial adjustment provide a low positive return or even a negative return. Consider the following case.

4.4 Rate of return depends on adjustment

Suppose that a large investment has been made in agricultural research and as a result many new more productive farm practices are developed. Suppose also that if an individual producer were to adopt these practices his output of farm products would increase percentage-wise much more than his total costs, resulting in a reduction in cost per unit of output. In this situation, an individual producer would have an incentive to adopt the practices. Since a change in his output could not affect price because he produces such a small part of total output, his total revenue (price times quantity) would increase in proportion to the increase in his output and this increase would be greater than his increase in cost. Thus, his income would be larger with adoption of the new practices, and he would obtain a favorable rate of return over cost on his investment.

Suppose now that many or all producers were to adopt the new practices and as a consequence total output in the farm industry increased substantially. If demand increases sufficiently, say to maintain stable prices, total revenue for the industry would increase more than total costs, resulting in an increase in total income and a positive rate of return over costs from the investment. On the other hand, suppose that demand does not increase. Then the greater output would sell for lower prices. If demand were not very responsive to a fall in prices, as is usually the case, at least in the more developed countries, total revenue would decline. Since total costs would be higher with the new practices, the income of producers generally would be lower. If the increase in farm output attributable to the new investment were valued at the prices now prevailing, the rate of return over costs might be quite low. At this stage, however, the farm industry has not adjusted fully to the impact of the new farming practices.

Suppose that at the time the new practices were introduced the industry was in good economic balance, i.e. there were no serious agricultural inefficiencies. With lower returns to farming resources because of the short-run effects of the new practices, the investment would have created an agricultural inefficiency, i.e. a disparity in resource returns which in this case would involve lower returns in farming than in other industries. Now if the industry were to adjust to this situation and sufficient resources were to shift from low return employments in farming to high return employments elsewhere, farm price would recover and the full income gains from the investment could be realized. Then the rate of return over cost would be greater. Part of the gain in national income would be reflected in an increase in the output of nonagricultural goods and services.

Thus, agricultural investments are not only a source of permanent increases in income but they also are a factor creating agricultural inefficiencies which offer opportunities to squeeze more income out of the investments. By creating agricultural inefficiencies, they also are a potent source of adjustment problems of the kind which characterize the agricultural sectors of some of the more developed countries.

Perhaps it is clear from what has been said that the estimation of expected rates of return over cost offered by alternative agricultural investment opportunities is no simple task. And this also is true even when the supply of basic data on the farm industry is large and of good quality as is the case in some countries. But without an adequate supply of the proper kind of data, the task is immeasurably greater.

5. *SELECTING AN AGRICULTURAL INVESTMENT PLAN*

To illustrate a procedure for developing an agricultural investment plan, it is assumed that estimates have been prepared of the expected rates of return over cost offered by alternative investment opportunities. In Table 10A hypothetical figures are used to represent these estimates. Four alternative investment outlets are identified -- A, B, C, and D. The first column indicates the level of investment expenditure in each outlet. The figures under column A show the expected rates of return over cost associated with each level of investment expenditure for outlet A. The figures under column B show the same for outlet B, and so on for outlets C and D.

A "demand schedule" for agricultural investment resources can be constructed from these data. This is done by determining the amount of investment resources that could be absorbed profitably at different "prices" for investment resources. These prices are expressed as rates of return and represent what investment resources might earn in nonagricultural outlets. For example, if the price were 40 per cent, A could absorb $1 million and D could absorb $3 million. At this price, outlets B and C could not absorb any investment resources because at the smallest level of investment (assumed to be $1 million) the rate of return that could be

Table 10A. HYPOTHETICAL (MARGINAL) RATES OF RETURN OVER COST FOR SELECTED AGRICULTURAL INVESTMENT OUTLETS

Investment level (millions of dollars)	Outlet and rate (percent) of return A Existing kinds of reproducible inputs	 B Irrigation	 C Agricultural education	 D Agricultural research
1	50	40	32	70
2	30	30	28	60
3	20	22	25	50
4	10	15	20	30
5	5	10	15	25
6	-1	5	12	20
7	-8	2	10	16
8	-12	-3	8	13
9	-18	-6	7	10
10	-24	-10	5	8
11	-30	-14	-2	0

earned would be less than 40 per cent. At a price of 30 per cent, A could absorb $2 million, B and C could absorb $1 million each and D could absorb $4 million, giving a total demand at that price of $5 million.

The demand schedule constructed in this way is presented in Table 10A. Prices are assumed to vary by intervals of 5 percentage points. With the demand schedule for agricultural investment, it is possible to determine how much total investment should be made in agriculture, given the expected return on investment resources in nonagricultural outlets. It also is possible to determine how this total should be allocated among different agricultural investment outlets. Both determinations are made on the assumption that the income gains from investment should be as large as possible.

For example, suppose the investment decision-makers decide that agricultural investment should earn at least 10 per cent to be competitive with nonagricultural investments. At a "price" of 10 per cent, according to the demand schedule, total agricultural investment would be at a level of $25 million. Of this total, $9 million would be allocated to outlet D, $7 million would go to C, $5 million to B and $4 million to A. If the "price" were lowered to 5 per cent, agriculture could absorb profitably a total of $31 million with $10 million allocated to D, $10 million allocated to C, $7 million going to B and $5 million absorbed by A.

In countries with highly decentralized economies, agricultural investment decisions are made by a large number of different individuals and institutions. These decisions are reflected in the level and pattern of total agricultural investment. Some are made

Table 10B. HYPOTHETICAL DEMAND SCHEDULE, FOR AGRICULTURAL INVESTMENT RESOURCES

		Outlet and amount absorbed (in millions of dollars)			
		A	B	C	D
Total	Price of investment resources[1] (percent)	Existing kinds of reproducible inputs	Irrigation	Agricultural education	Agricultural research
2	60	0	0	0	2
2	55	0	0	0	2
4	50	1	0	0	3
4	45	1	0	0	3
5	40	1	1	0	3
5	35	1	1	0	3
9	30	2	2	1	4
12	25	2	2	3	5
16	20	3	3	4	6
19	15	3	4	5	7
25	10	4	5	7	9
31	5	5	6	10	10
33	0	5	7	10	11

[1] Expected rate of return over cost in nonagricultural investment outlets.

by government legislative bodies, e. g. when funds are appropriated for agricultural education and research. Others are made by farm managers and other private individuals and groups in agricultural related businesses. Investment decisions in the private sector usually are more heavily income or market oriented than those in the public sector. Although investment goals may differ, decision-makers in both sectors, nevertheless, face the problem of evaluating alternative investment opportunities in terms of the goals to be achieved. For this purpose, appropriate input, output and pricing data are needed. The larger the effective supply of these data the more rational can be the investment decision-making process whether government or private.

Questions

1. Describe the "agricultural efficiency approach" to agricultural development.
2. Is the elimination of inefficiencies a "permanent" source of economic growth?
3. What influences the contribution of investment to agricultural development?
4. Describe a type of kind of inefficiency that might occur in agriculture and indicate the kinds of data that would be needed to evaluate the benefits and costs of eliminating the inefficiency.
5. Prepare a listing of agricultural investment alternatives.
6. Describe the kinds of data needed for agricultural investment planning.
7. Develop an example to illustrate an "agricultural investment demand schedule" and show how this may be used in developing an agricultural investment plan.

References for Further Study

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